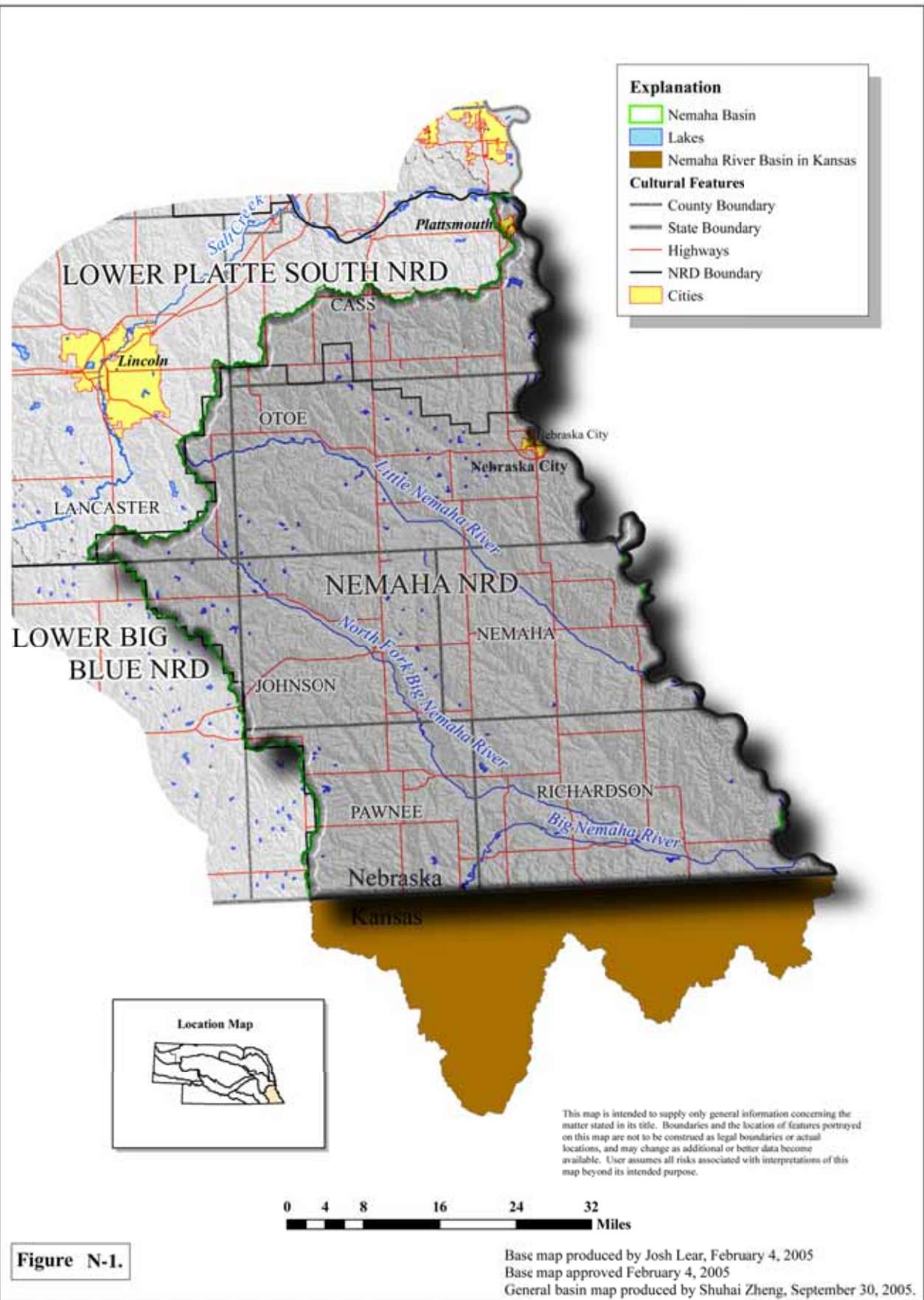




Planning and Assistance Division

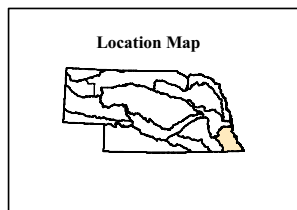
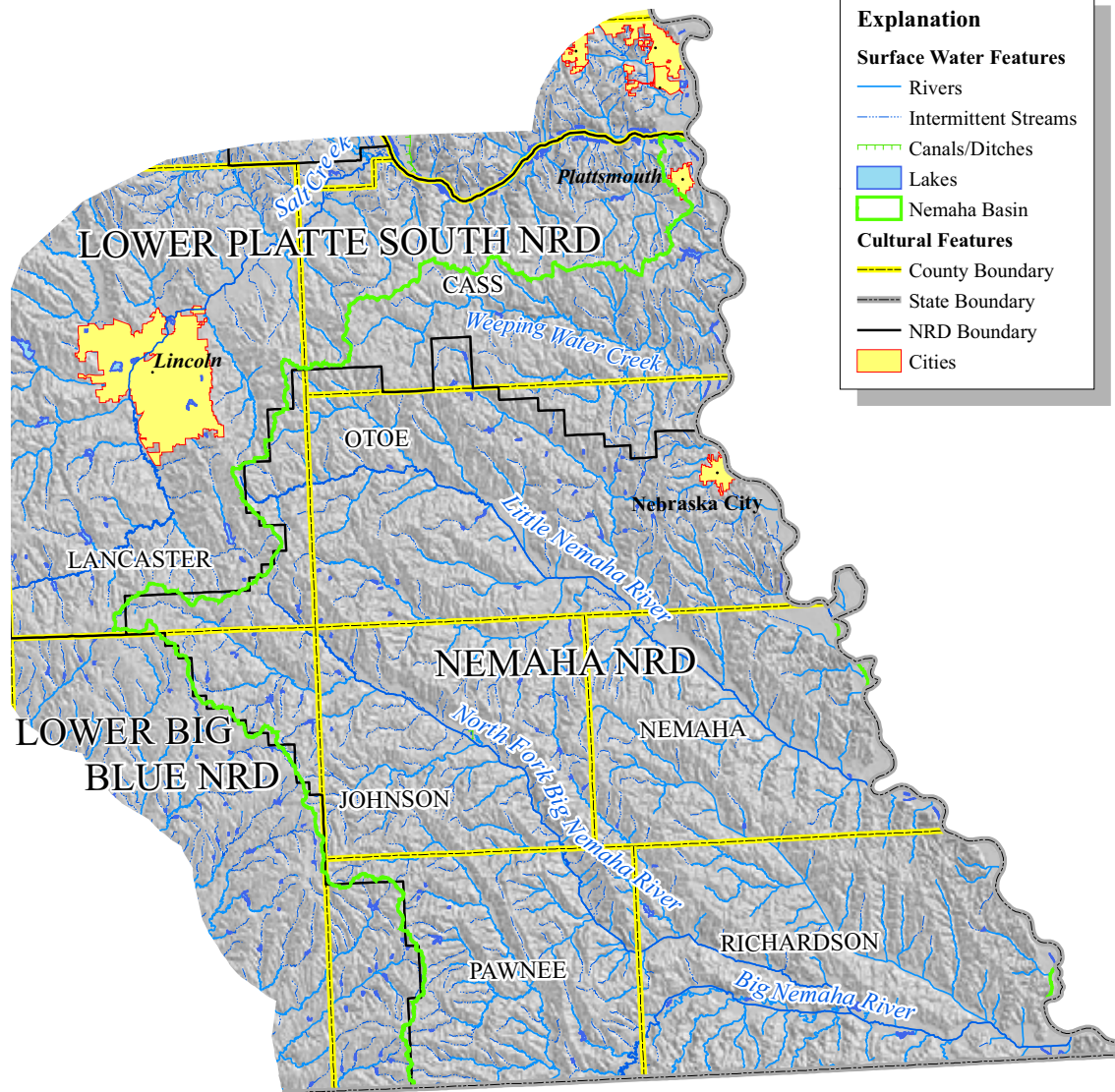
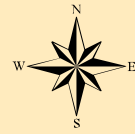
GENERAL BASIN MAP NEMAHA RIVER BASIN





Planning and Assistance Division

General Surface Water Features NEMAHA RIVER BASIN



This map is intended to supply only general information concerning the matter stated in its title. Boundaries and the location of features portrayed on this map are not to be construed as legal boundaries or actual locations, and may change as additional or better data become available. User assumes all risks associated with interpretations of this map beyond its intended purpose.

0 4 8 16 24 32
Miles

Figure N-2.

Base map produced by Josh Lear, February 4, 2005

Base map approved February 4, 2005

General surface water features map produced by Shuhai Zheng, September 30, 2005.

Figure N-3. Annual Precipitation at Auburn, Nebraska.

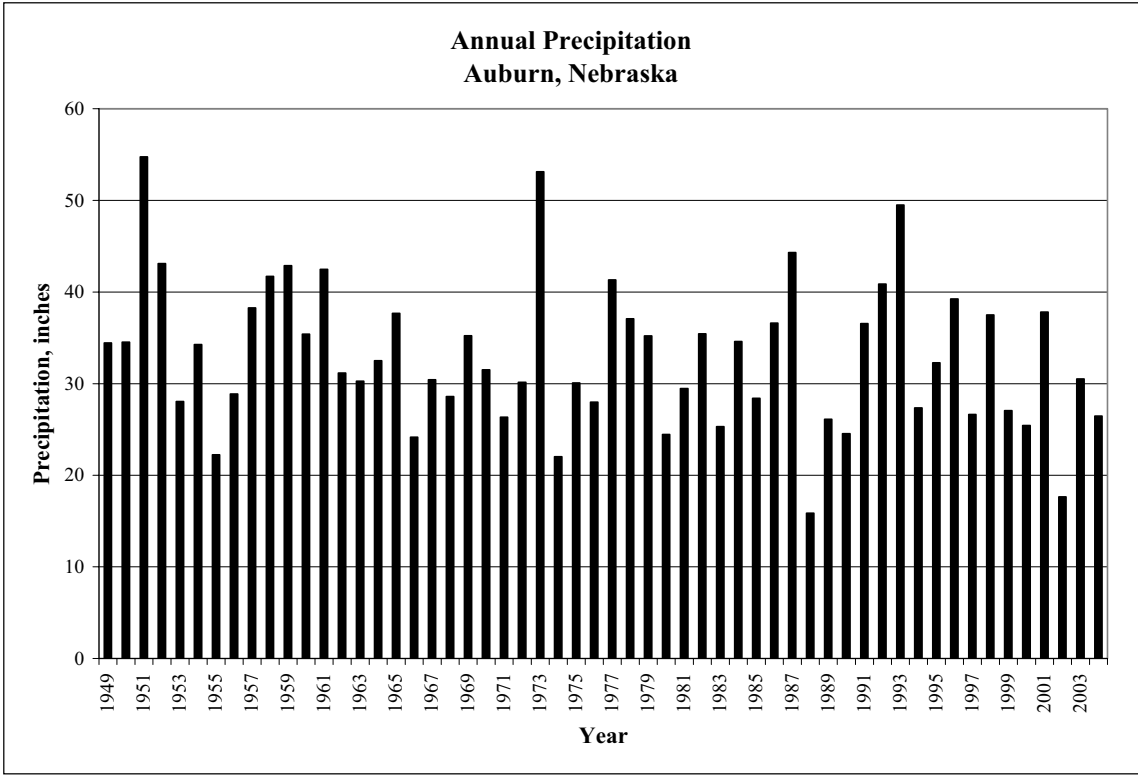
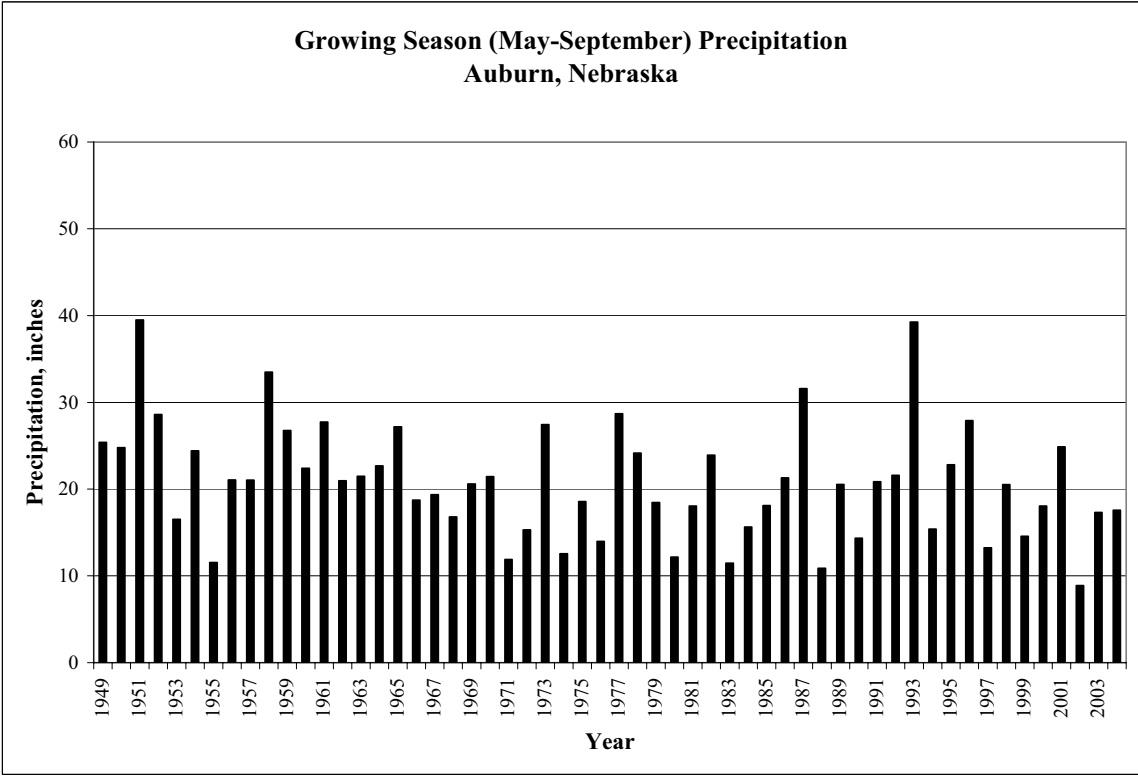


Figure N-4. Growing Season (May-September) Precipitation at Auburn, Nebraska.



Source: High Plains Climate Center

Figure N-5. Annual Precipitation at Falls City, Nebraska.

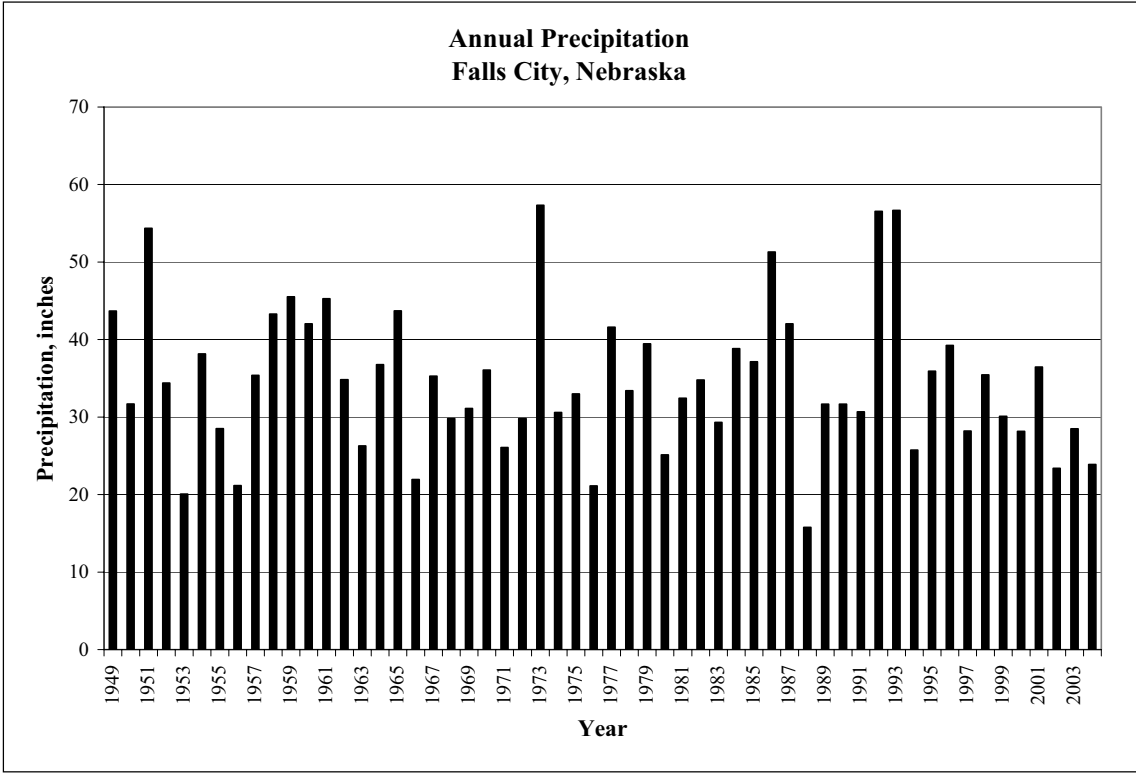
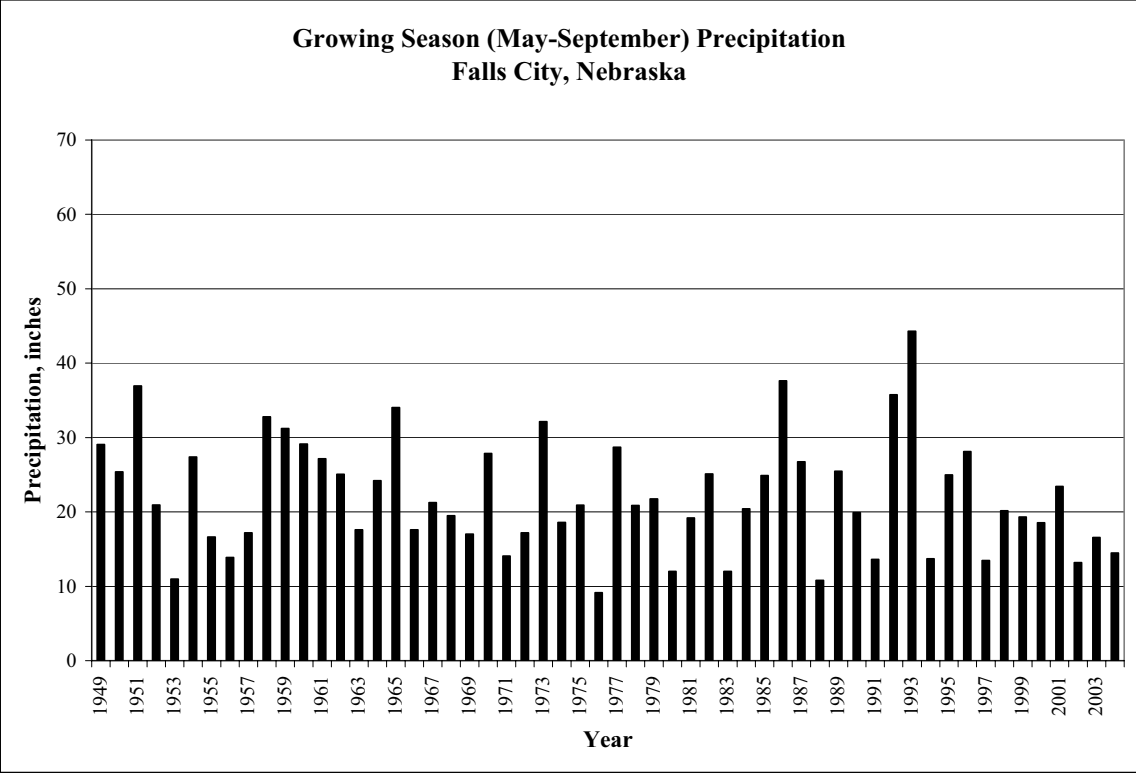


Figure N-6. Growing Season (May-September) Precipitation at Falls City, Nebraska.



Source: High Plains Climate Center

Figure N-7. Annual Precipitation at Nebraska City, Nebraska.

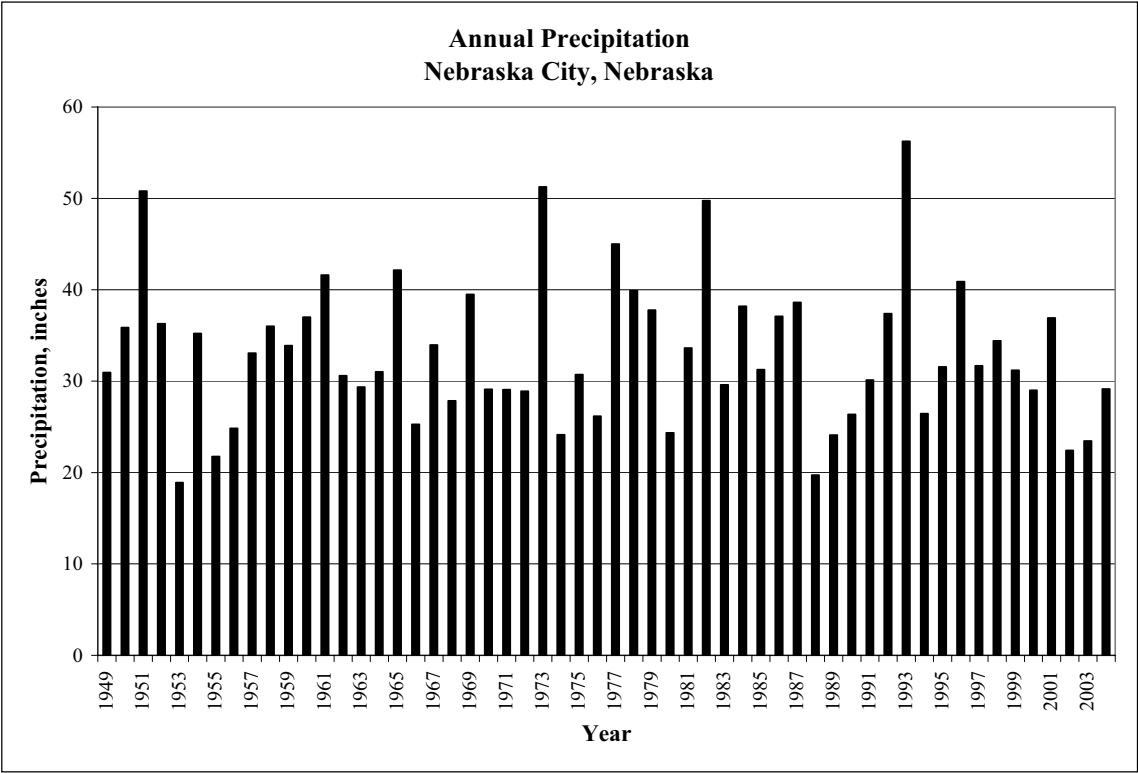
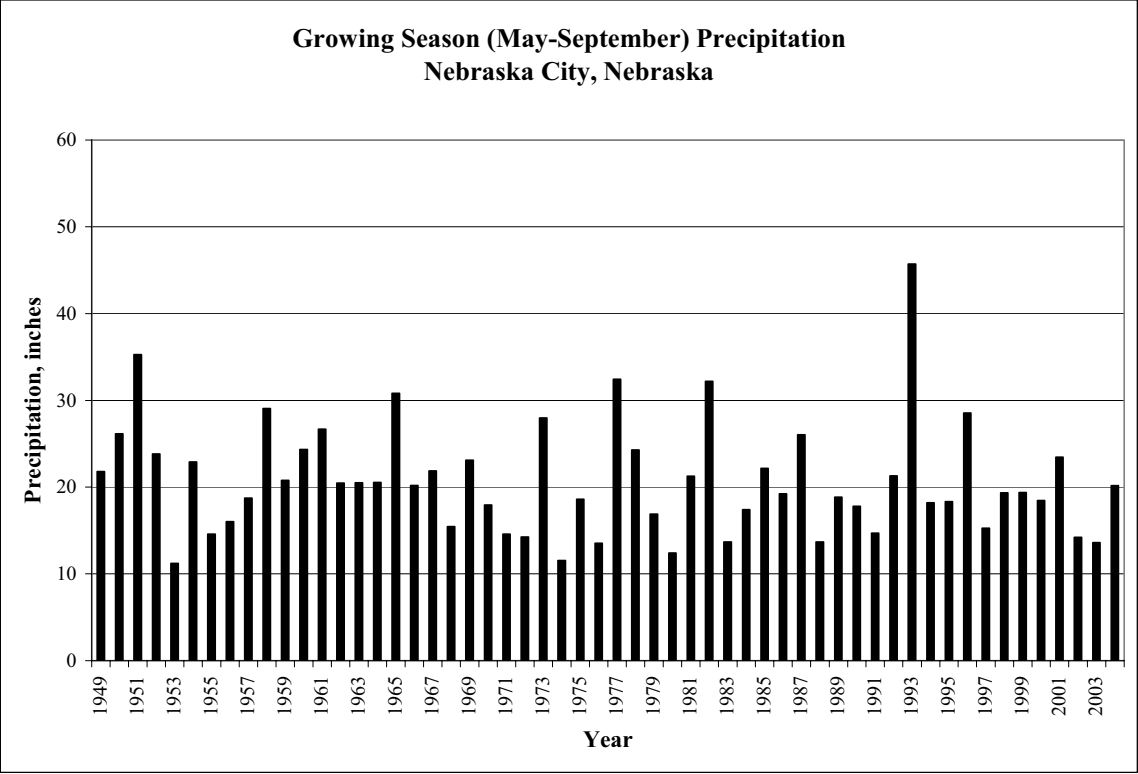


Figure N-8. Growing Season (May-September) Precipitation at Nebraska City, Nebraska.



Source: High Plains Climate Center

Figure N-9. Annual Precipitation at Tecumseh, Nebraska.

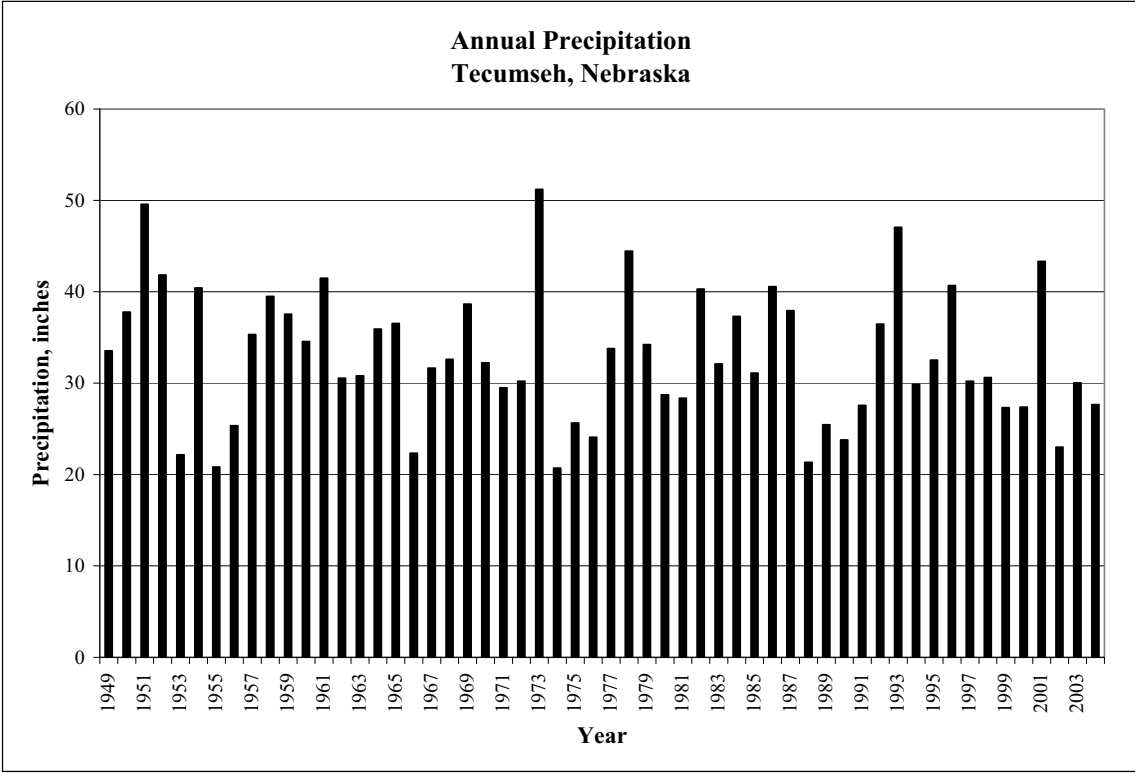
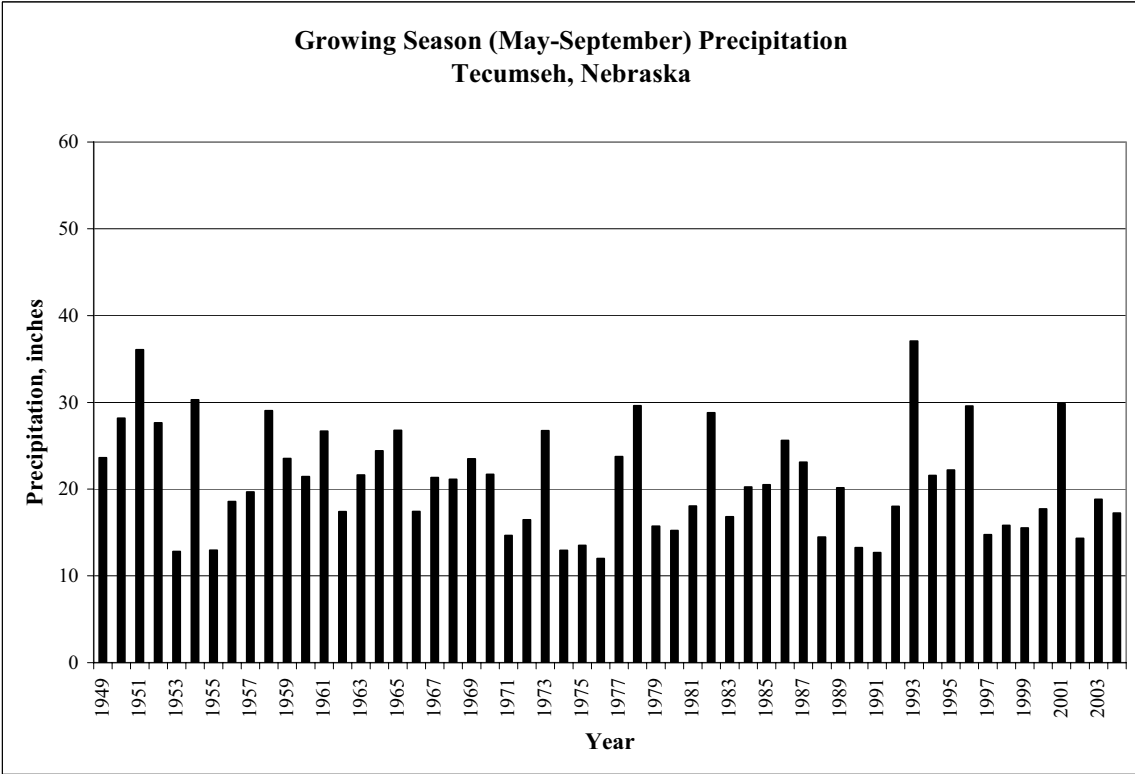


Figure N-10. Growing Season (May-September) Precipitation at Tecumseh, Nebraska.

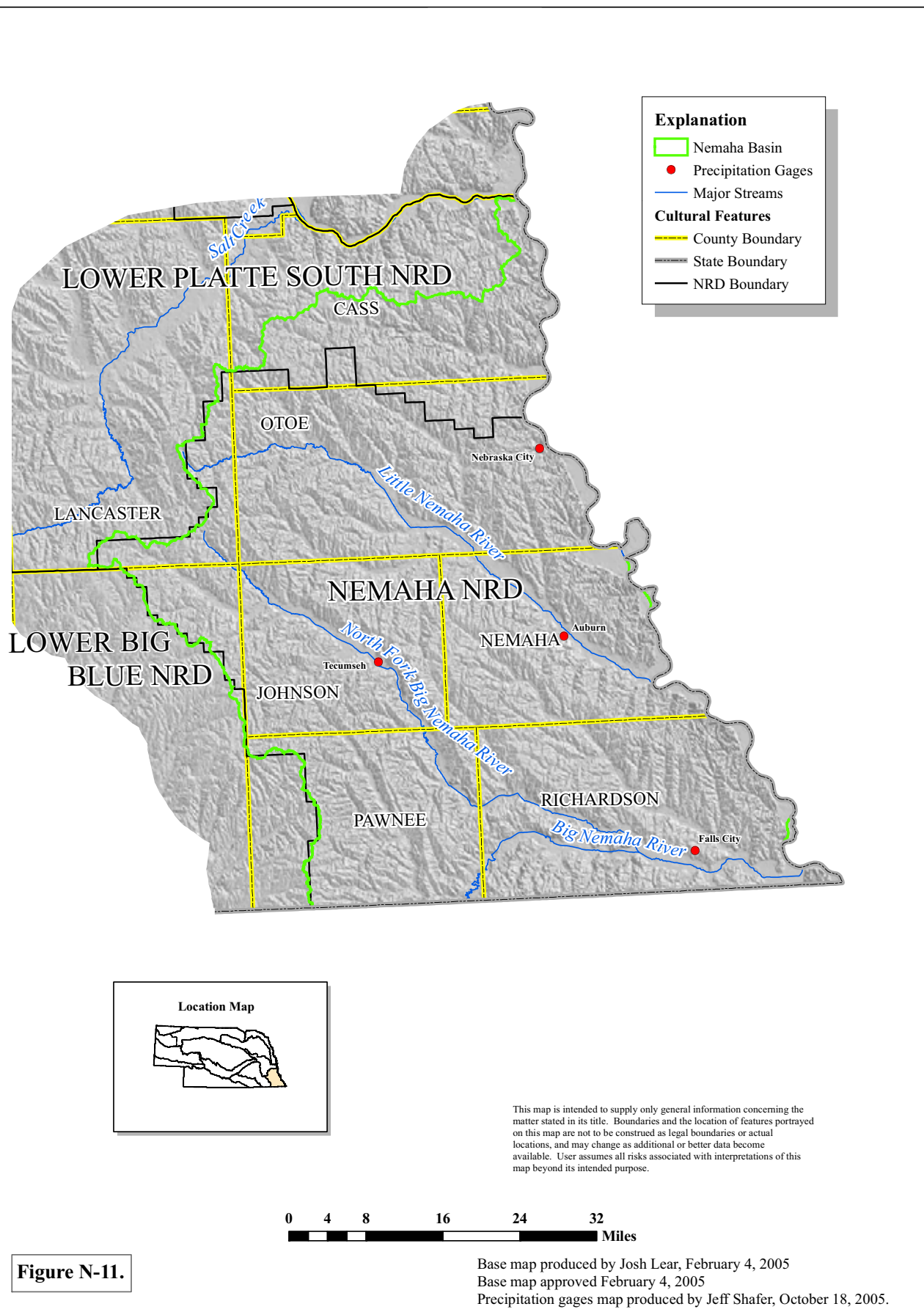


Source: High Plains Climate Center



Planning and Assistance Division

Precipitation Gages NEMAHA RIVER BASIN





Planning and Assistance Division

Glacial Till NEMAHA RIVER BASIN

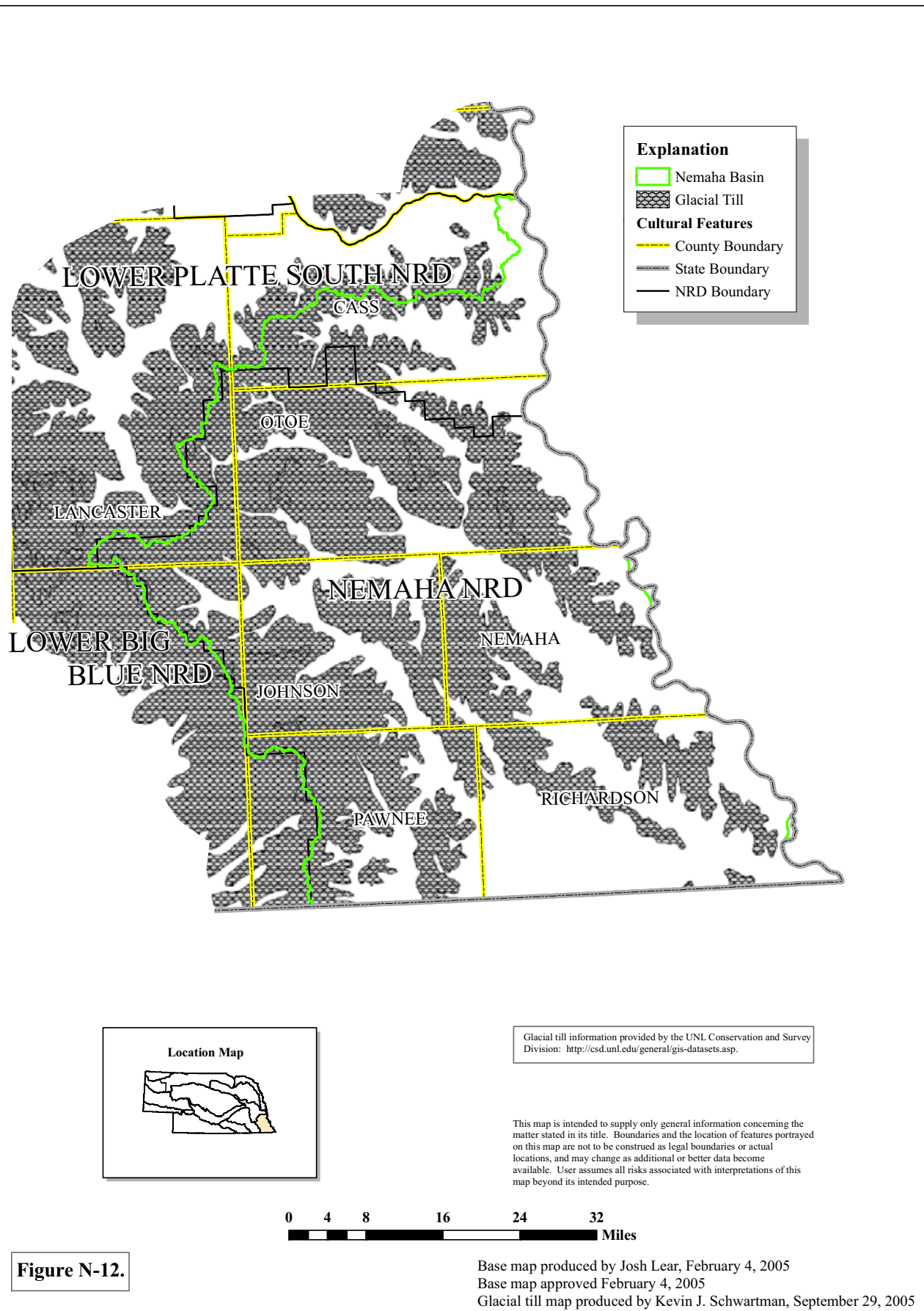


Table N-1. – Aquifers in unconsolidated surficial deposits (modified from (modified from Condra and Reed, 1959; NNRD, 1995; Tanner and Steele, 1991)

System	Hydrogeologic unit	Character and description	Maximum thickness, in feet	Hydrogeologic characteristics
Quaternary	Shallow aquifers	Shallow Holocene alluvium in valleys and discontinuous Pleistocene sand and gravel lenses in predominately fine-grained deposits.	150	Generally are unconfined to semi-confined and might be hydraulically connected to surface-water systems, other shallow aquifers or paleovalley alluvial aquifers. Wells generally yield 50 to 700 gal/min. Discontinuous sand and gravel lenses generally are confined to semi-confined and may be hydraulically connected. wells yield water at 10 to 100 gal/min.
	Missouri River Alluvial Aquifer	Predominately sand, gravel and silt deposits. Deposits are located within the incised bedrock valley of the Missouri River.	150	A major aquifer that generally is unconfined to semi-confined and hydraulically connected with the Missouri River. Wells generally yield 300 to 700 gal/min, and locally yield as much as 1,500 gal/min.
	Paleovalley Alluvial Aquifers	Predominately sand and gravel deposits within bedrock valleys. Basic directional trend of paleovalleys seems to be west to east.	<200	Major aquifers that are generally semi-confined to confined. Might be hydraulically connected to local shallow aquifers and surface-water systems. Wells yield 500 to 1,000 gal/min and locally as much as 1,500 gal/min.

Table N-2. – Characteristics of bedrock aquifers (modified from Condra and Reed, 1959; NNRD, 1995; Tanner and Steele, 1991)

System	Hydrogeologic unit	Character and description	Maximum thickness, in feet	Hydrogeologic characteristics
Cretaceous	Dakota Sandstone	Predominately massive to cross-bedded friable sandstone with interbedded clayey to slightly sandy shales. Sandstone may contain ironstone or spherulitic siderite concretions, chert pebbles. Sandstones and shales may be micaceous.	<100	Generally an unconfined or semi-confined aquifer. Wells can yield 50 to 750 gallons gal/min. Might be hydraulically connected to saturated sand and gravels in overlying unconsolidated deposits.
Permian	Aquifer In Chase Group	Predominately gray clayey shale with interbedded to massive limestones. Limestones may be geodal, fossiliferous, or very cherty. Some shales are massive. Lower third of unit has scattered beds of shale-sandstones, mudstone-shales and limestone-sandstones.	170	Generally an unconfined or semi-confined aquifer. Wells can yield 20 to 50 gal/min in areas where secondary porosity has developed in fractured limestones. Might be hydraulically connected to saturated sand and gravel. In overlying unconsolidated deposits.
	Aquifer in Council Grove Group	Predominately clayey shales with interbedded, massive, blocky, clayey limestones. Some limestones may be fossiliferous. Shales may be laminated, micaceous, sandy, calcareous, blocky or contain fine gypsum.	320	Generally an unconfined or semi-confined aquifer. Wells can yield 20 to 50 gal/min in areas where secondary porosity has developed in fractured limestones. May be a confining layer to local underlying sand-stones and be hydraulically connected to saturated sand and gravel in overlying unconsolidated deposits.
	Aquifer in Admire	Predominately shale with interbedded, porous, clayey	130	Generally a semi-confined or confined

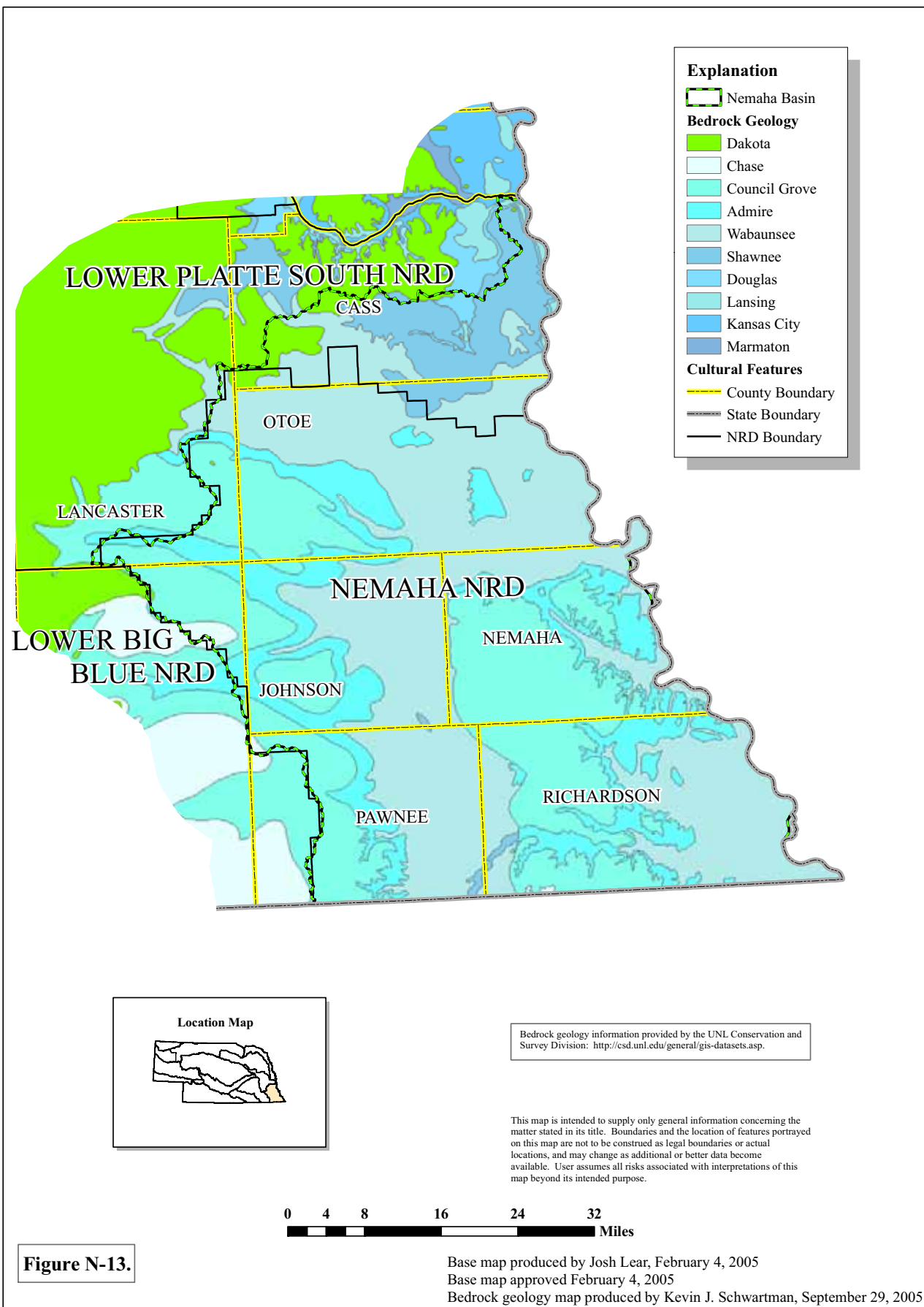
Table N-2. – Characteristics of bedrock aquifers--Continued

System	Hydrogeologic unit	Character and description	Maximum thickness, in feet	Hydrogeologic characteristics
	Group	limestone and shale. Top 45 ft. of shale contains 12- to 18-foot bed of fine-grained sandstone. Basal sandstones 0 to 50 feet thick occur locally.	180 with local basal sandstones	aquifer. Wells developed in fractured development zones in the limestone can yield 20 to 50 gal/min as a result of secondary porosity. Local basal sandstone might slightly increase yield. Might be hydraulically connected to saturated sand and gravels in overlying unconsolidated deposits.
Pennsylvanian	Aquifer in Wabaunsee Group	Predominately clayey shale with some beds of limestone. Limestone may contain lenses or thin interbedded sandstones and coal beds. Limestone and shale may be fossiliferous.	400	Not a major aquifer. Some wells developed in the limestone generally yield 20 to 50 gal/min as a result of the secondary porosity from fracturing. Some of the interbedded sandstones might be hydraulically connected.
	Aquifer in Shawnee Group	Predominately interbedded to massive limestones with clayey shales. Limestones and shales may be highly fossiliferous.	175	Not a major aquifer. Because of secondary fracturing, some wells can be completed in the limestone sequences. Generally wells yield 20 to 50 gal/min.



Planning and Assistance Division

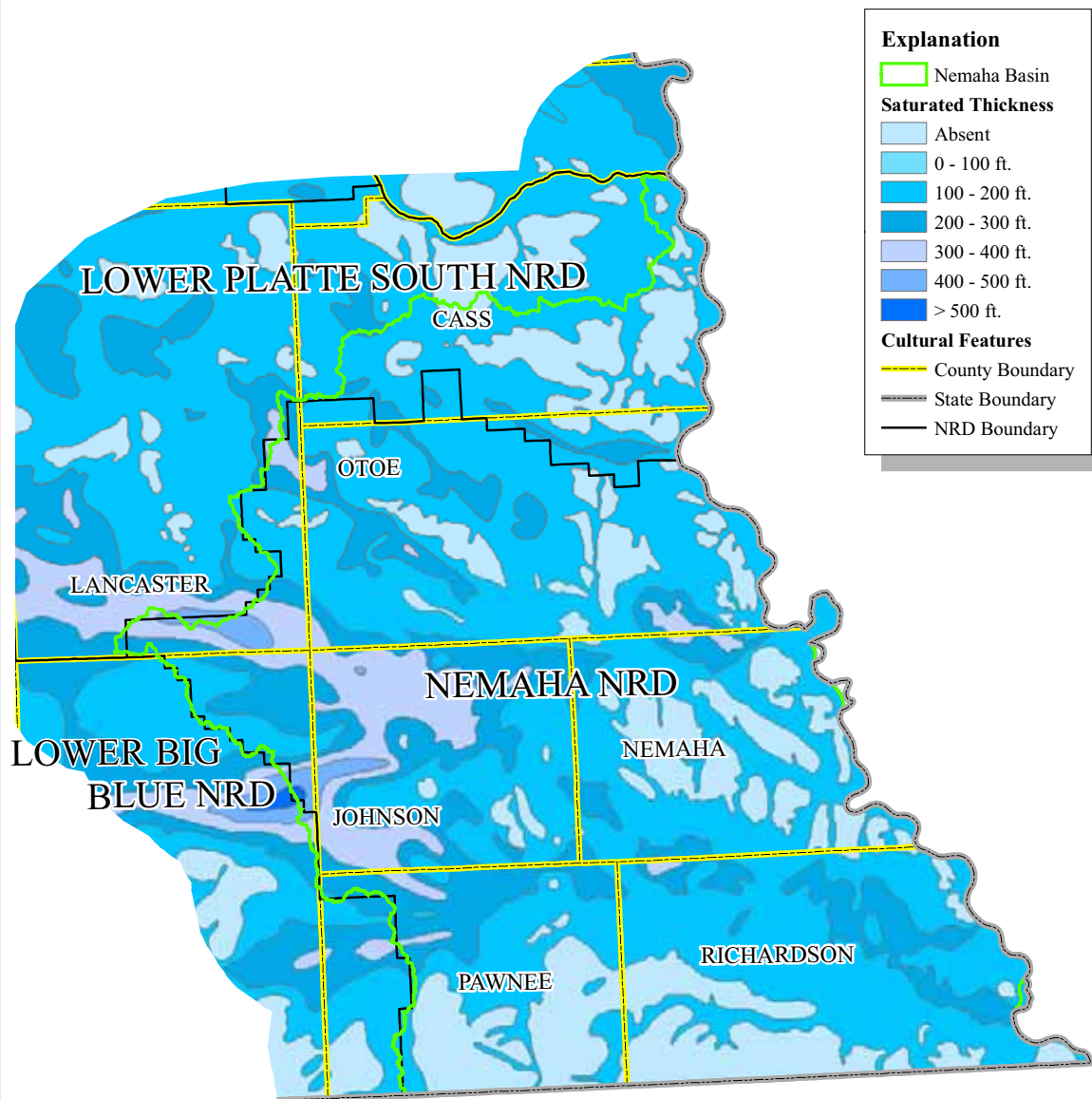
Bedrock Geology NEMAHA RIVER BASIN





Planning and Assistance Division

Saturated Thickness NEMAHA RIVER BASIN



Explanation

Nemaha Basin

Saturated Thickness

Absent

0 - 100 ft.

100 - 200 ft.

200 - 300 ft.

300 - 400 ft.

400 - 500 ft.

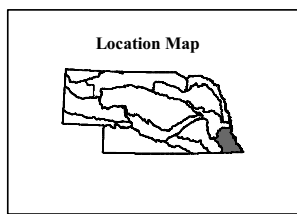
> 500 ft.

Cultural Features

County Boundary

State Boundary

NRD Boundary



Saturated thickness information provided by the UNL Conservation and Survey Division: <http://csd.unl.edu/general/gis-datasets.asp>.

This map is intended to supply only general information concerning the matter stated in its title. Boundaries and the location of features portrayed on this map are not to be construed as legal boundaries or actual locations, and may change as additional or better data become available. User assumes all risks associated with interpretations of this map beyond its intended purpose.

0 4 8 16 24 32
Miles

Figure N-14.

Base map produced by Josh Lear, February 4, 2005

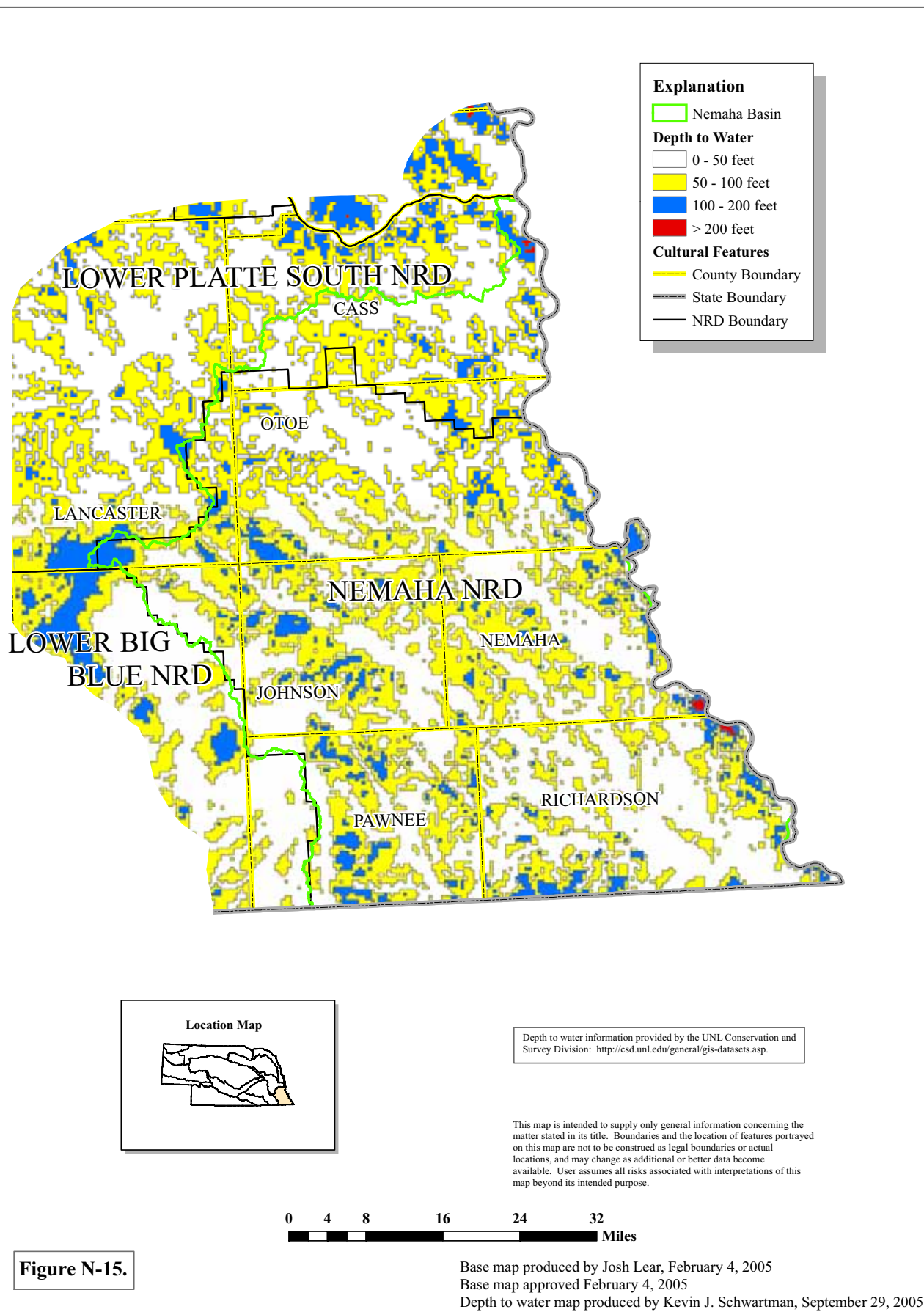
Base map approved February 4, 2005

Saturated thickness map produced by Kevin J. Schwartman, September 29, 2005



Planning and Assistance Division

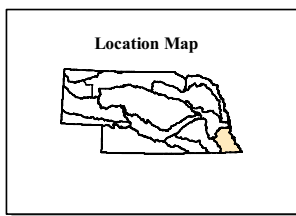
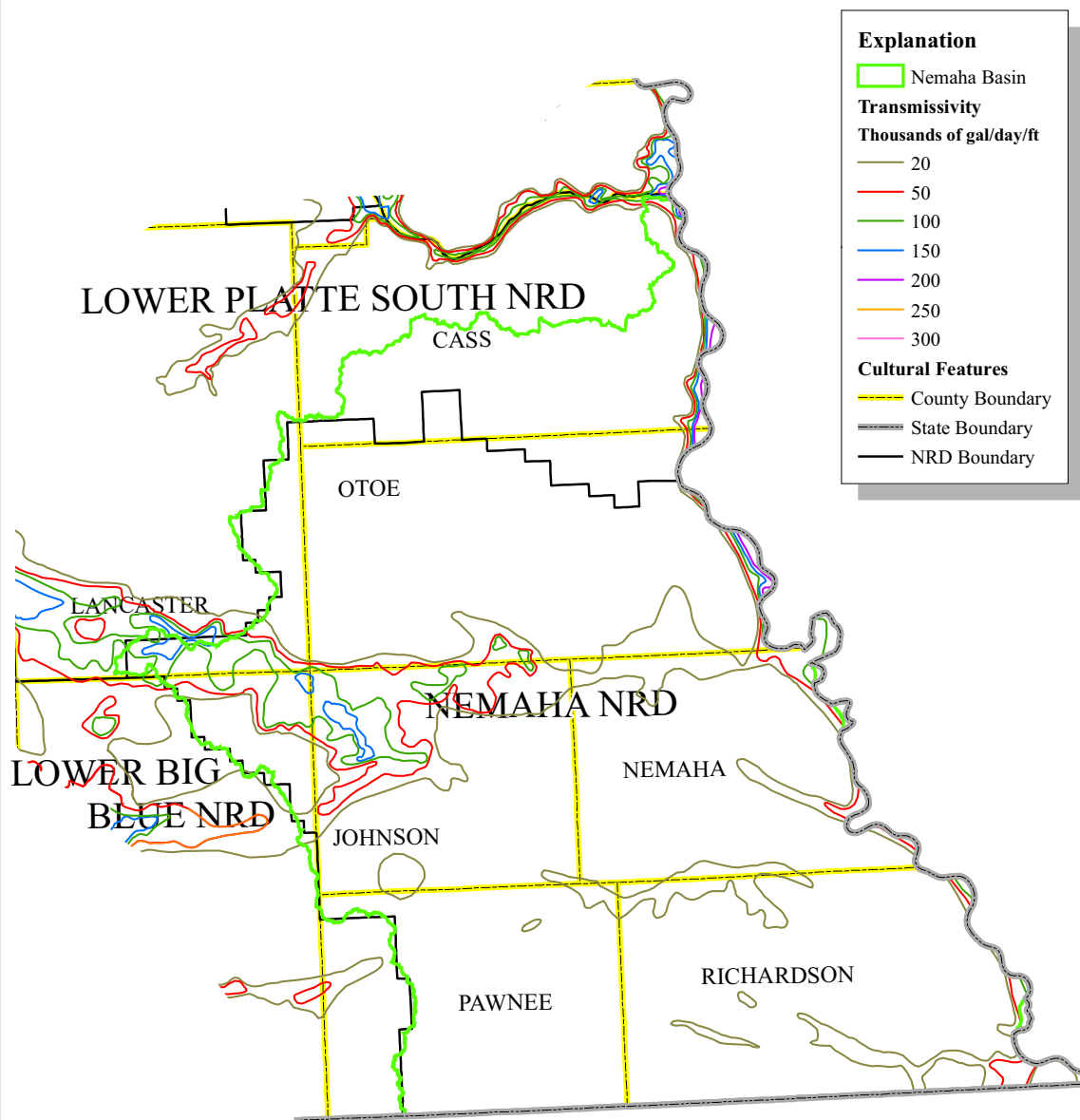
Depth to Water NEMAHA RIVER BASIN





Planning and Assistance Division

Transmissivity NEMAHA RIVER BASIN



Transmissivity information provided by the UNL Conservation and Survey Division in: Summerside, S., Olafsen-Lackey, S., Goeke, J., and Myers, W., 2005, Mapping of Aquifer Properties – Transmissivity and Specific Yield – for Selected River Basins in Central and Eastern Nebraska.

This map is intended to supply only general information concerning the matter stated in its title. Boundaries and the location of features portrayed on this map are not to be construed as legal boundaries or actual locations, and may change as additional or better data become available. User assumes all risks associated with interpretations of this map beyond its intended purpose.

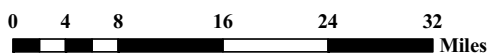


Figure N-16.

Base map produced by Josh Lear, February 4, 2005

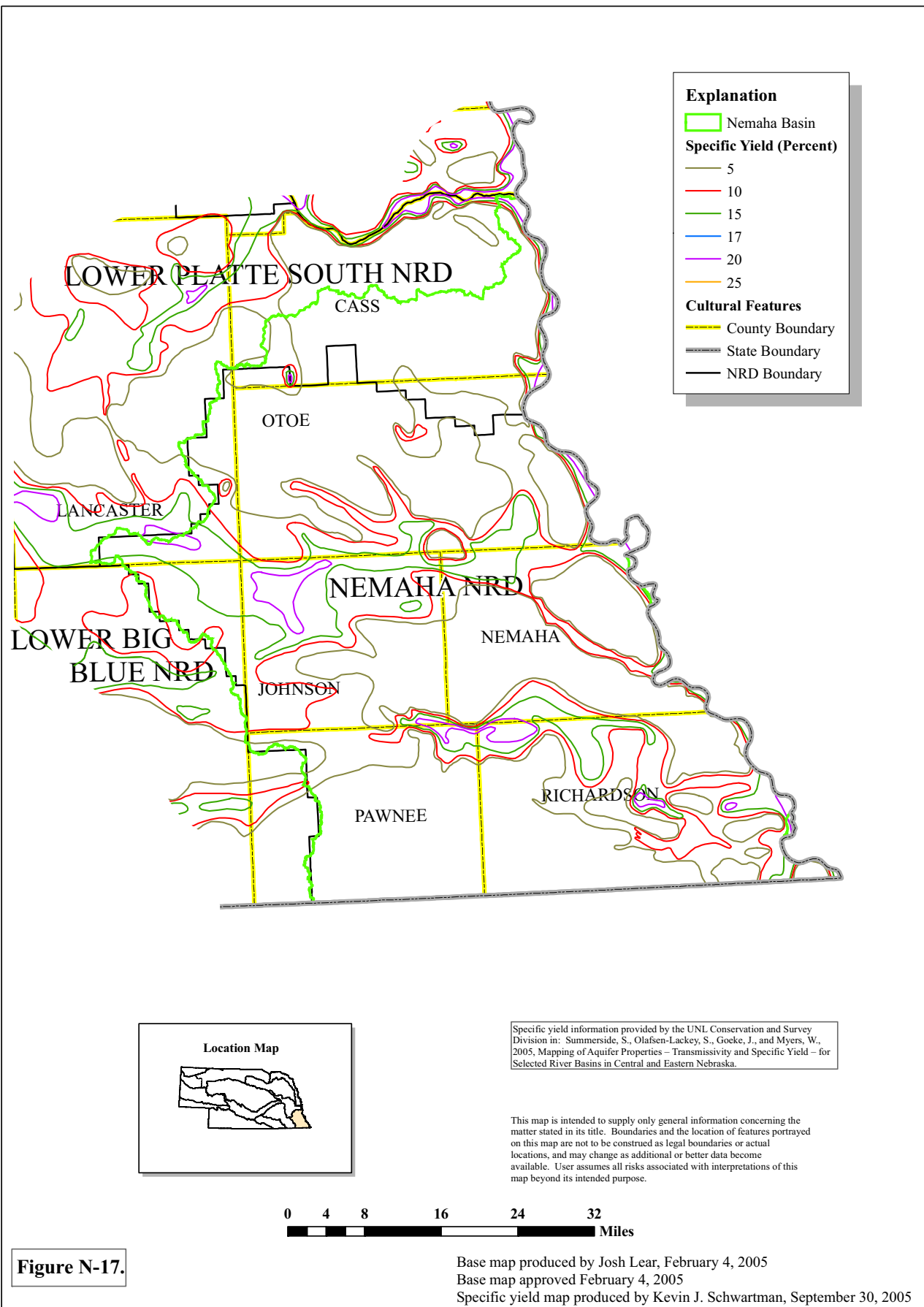
Base map approved February 4, 2005

Transmissivity map produced by Kevin J. Schwartzman, September 29, 2005



Planning and Assistance Division

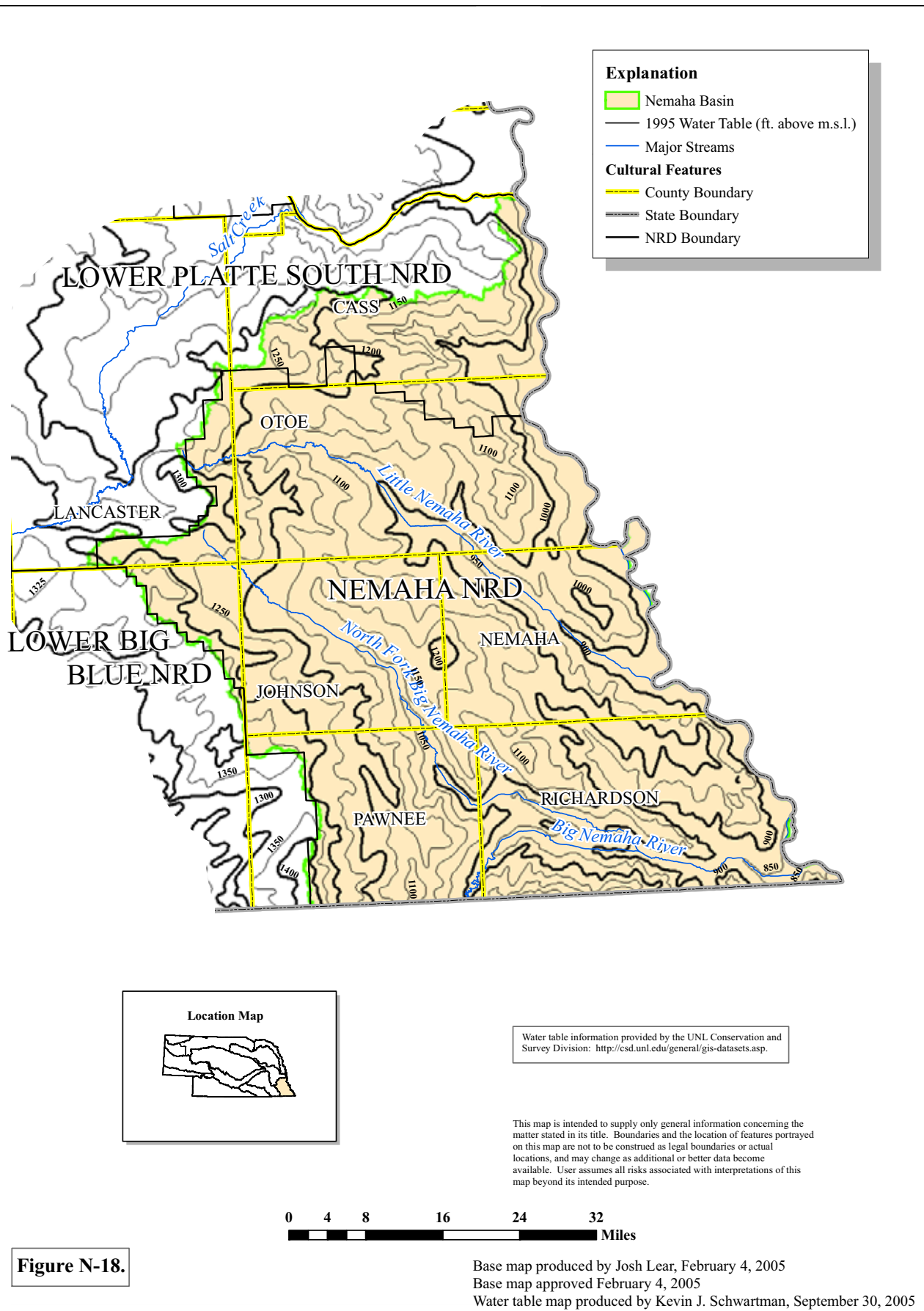
Specific Yield NEMAHA RIVER BASIN





Planning and Assistance Division

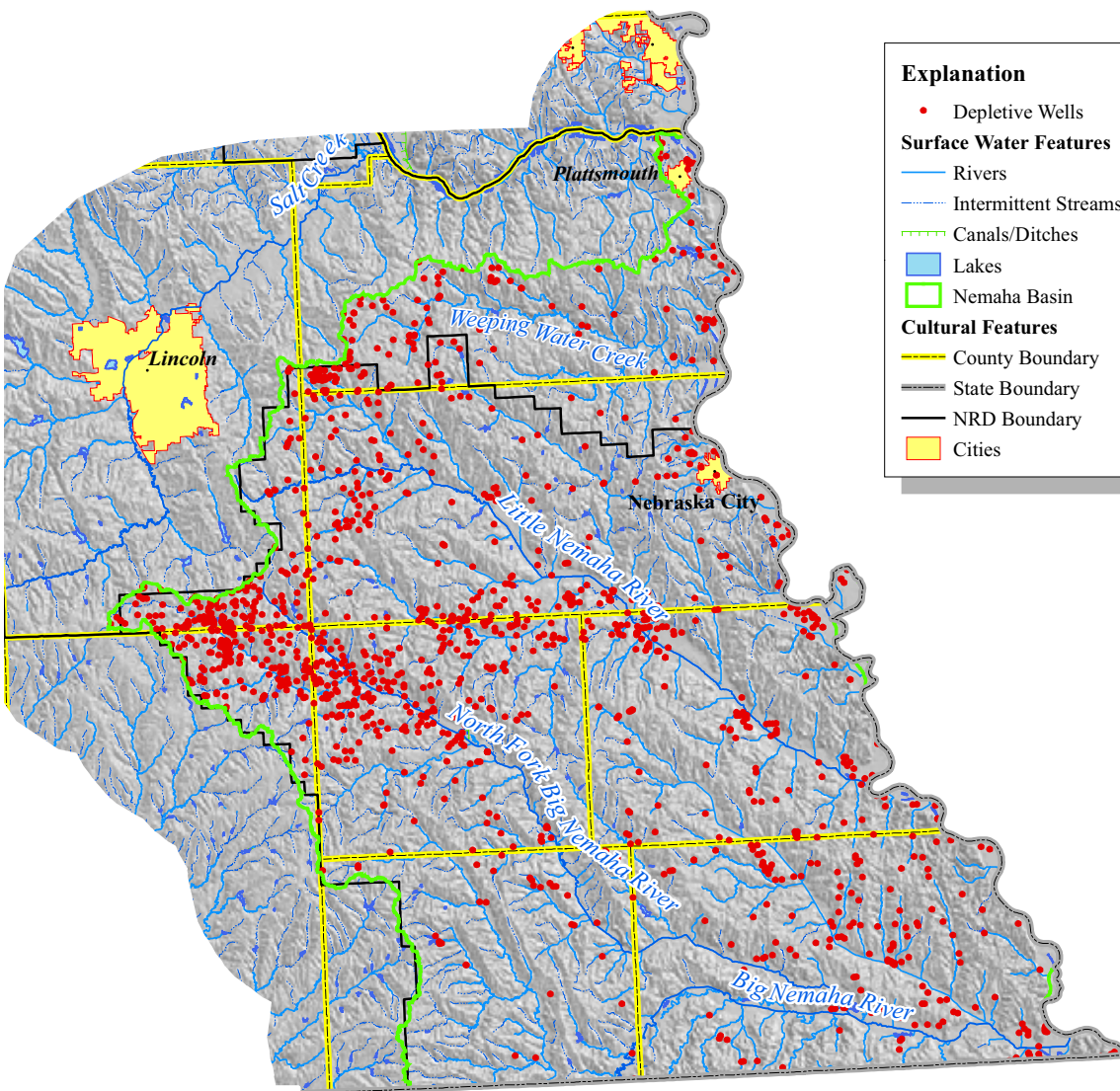
1995 Ground Water Table NEMAHA RIVER BASIN





Planning and Assistance Division

Depletive Ground Water Wells NEMAHA RIVER BASIN



Explanation

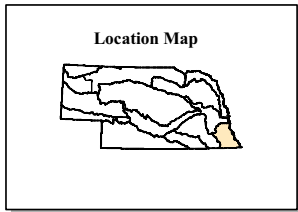
- Depletive Wells

Surface Water Features

- Rivers
- - - Intermittent Streams
- Canals/Ditches
- Lakes
- Nemaha Basin

Cultural Features

- - - County Boundary
- State Boundary
- NRD Boundary
- Cities



Depletive well information is from the DNR Registered Ground Water Well Database, as of October 1, 2005, and includes wells used for aquaculture, commercial, domestic, irrigation, public water supply, dewatering, stock and others except wells for non-consumptive uses.

This map is intended to supply only general information concerning the matter stated in its title. Boundaries and the location of features portrayed on this map are not to be construed as legal boundaries or actual locations, and may change as additional or better data become available. User assumes all risks associated with interpretations of this map beyond its intended purpose.

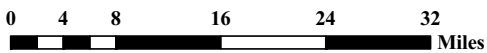


Figure N-19.

Base map produced by Josh Lear, February 4, 2005
Base map approved February 4, 2005
Depletive ground water wells map produced by Shuhai Zheng, September 30, 2005.



Planning and Assistance Division

High Capacity Wells by Completion Date NEMAHA RIVER BASIN

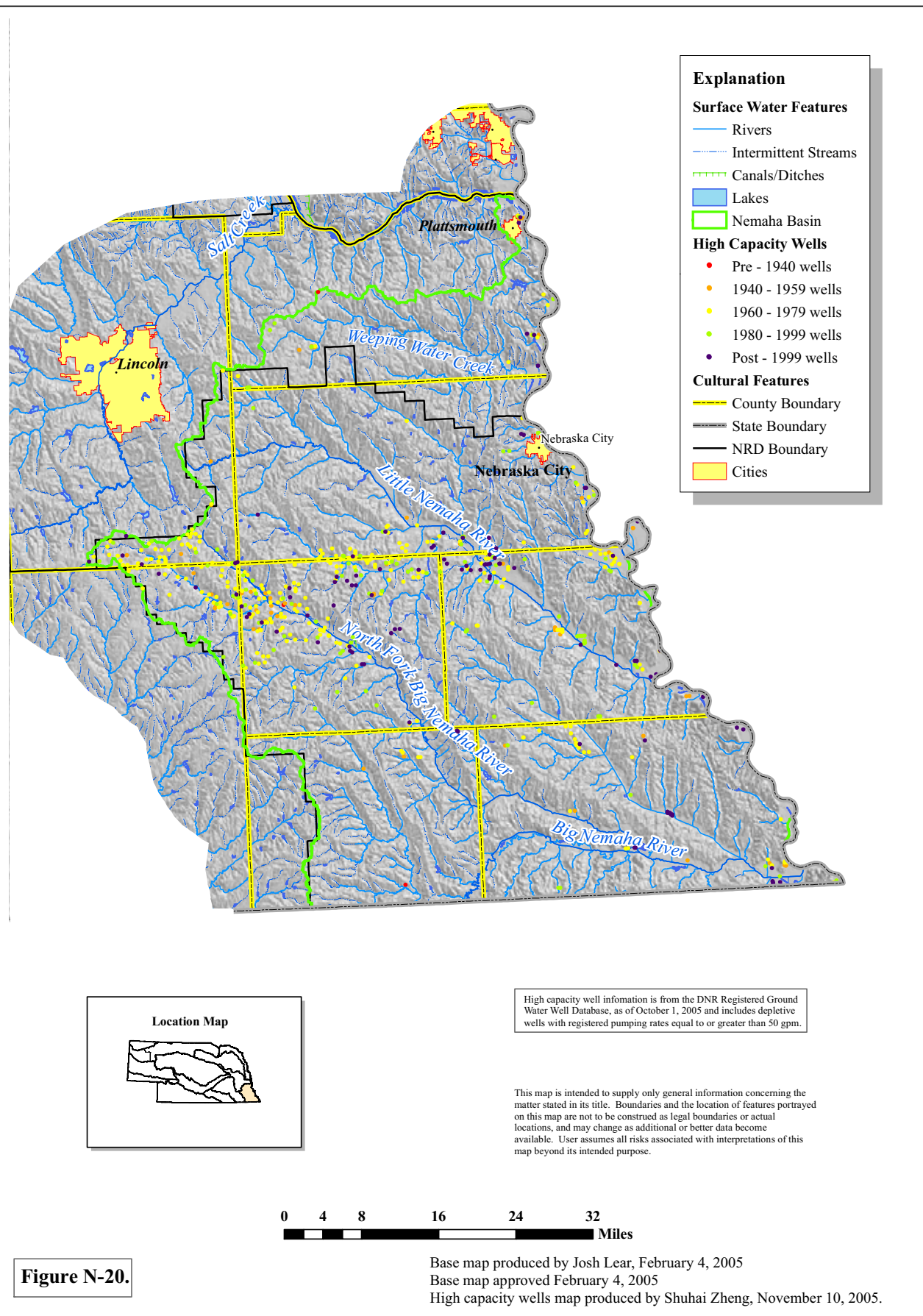


Figure N-20.

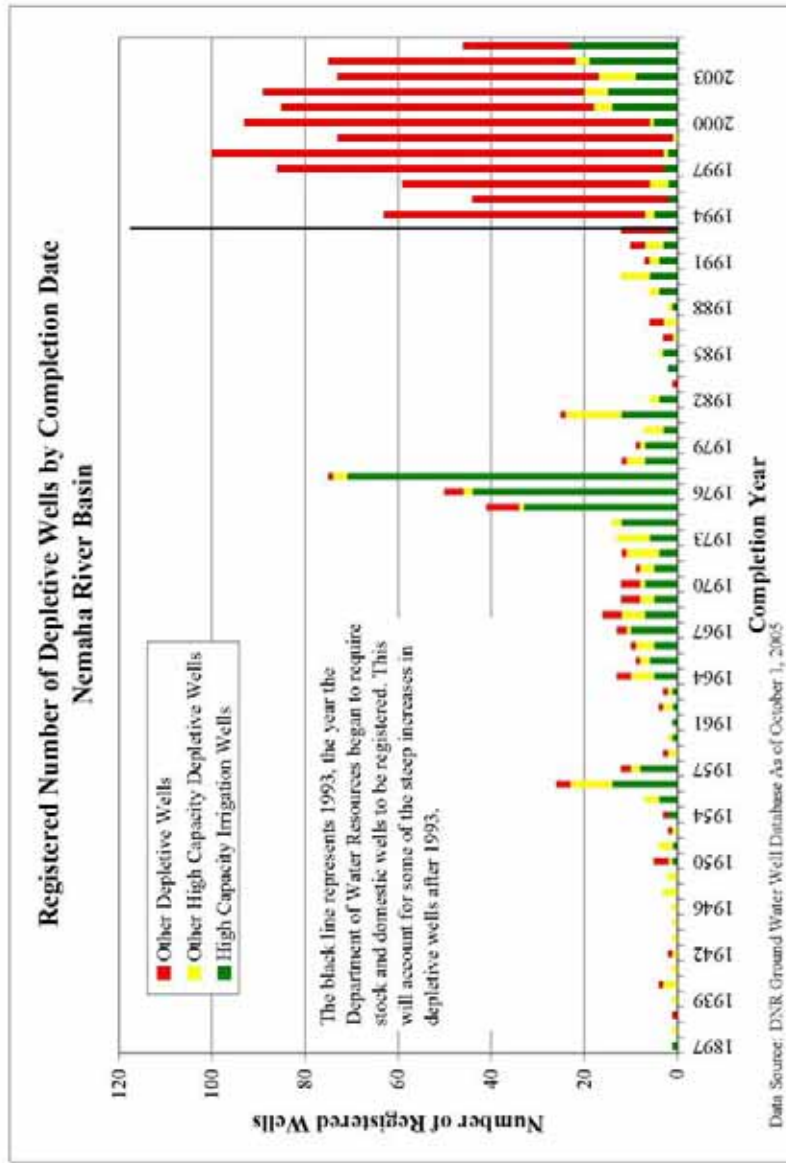


Figure N-21

By Shuhai Zheng, 10/1/2005

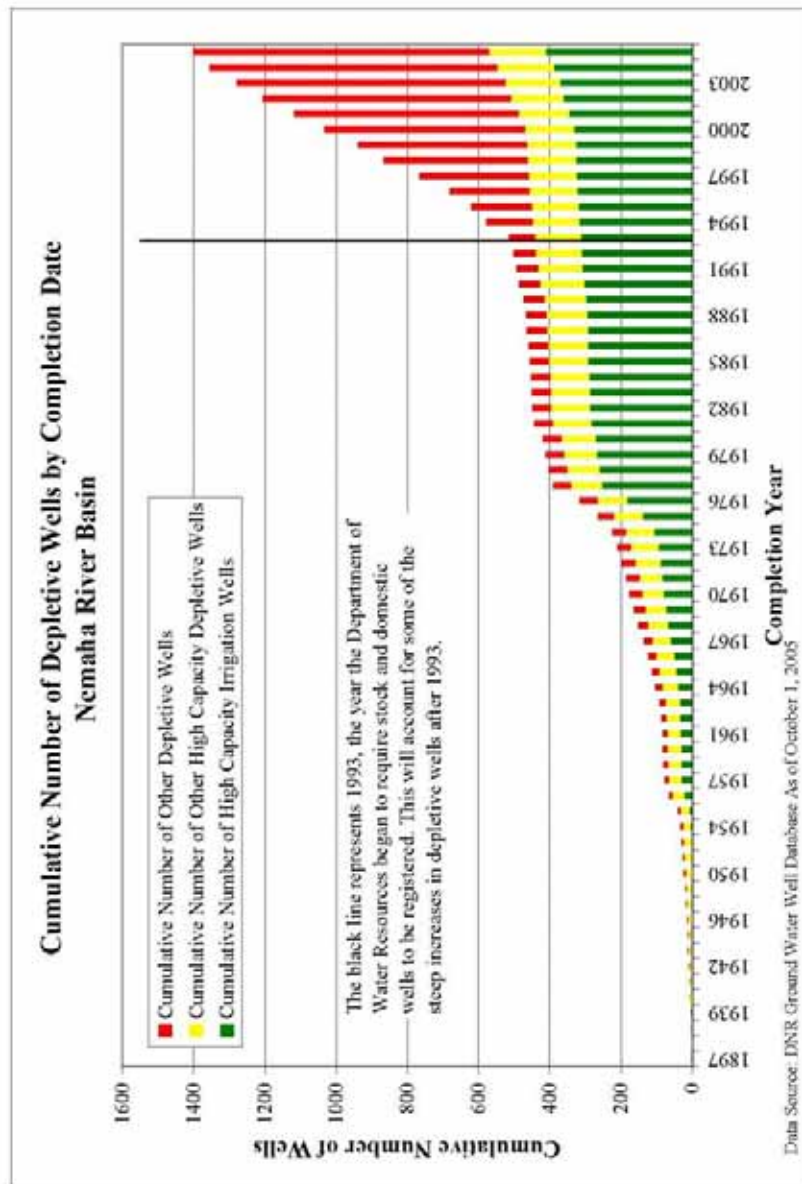


Figure N-22

By Shuhai Zheng, 10/1/2005

Table N-3. Average Irrigated Acreage 1950-2003 for Counties Fully or Partially in the Nemaha River Basin

County Name	Percent of County in Nemaha Basin	Estimated Average Irrigated Acreage by County					
		1950-1959	1960-1969	1970-1979	1980-1989	1990-1999	2000-2003
Cass	53	499	768	2265	4070	2720	1950
Gage	10	2719	15576	36687	45190	49700	57275
Johnson	100	740	1516	5310	8960	10410	10650
Lancaster	12	980	4445	9841	13600	12650	12925
Nemaha	100	211	386	1942	3680	3650	3625
Otoe	100	204	647	4261	5250	3380	4300
Pawnee	77	176	163	1181	2720	3650	2700
Richardson	100	260	292	1086	2040	1390	767
Total		5790	23792	62573	85510	87550	94192
Change from Previous 10 Years			310.95%	163.00%	36.66%	2.39%	7.59%

* The percentage is the percentage of the county area which is in the Nemaha Basin. It does not necessarily represent the percentage of irrigated county acreage in the Nemaha River Basin.

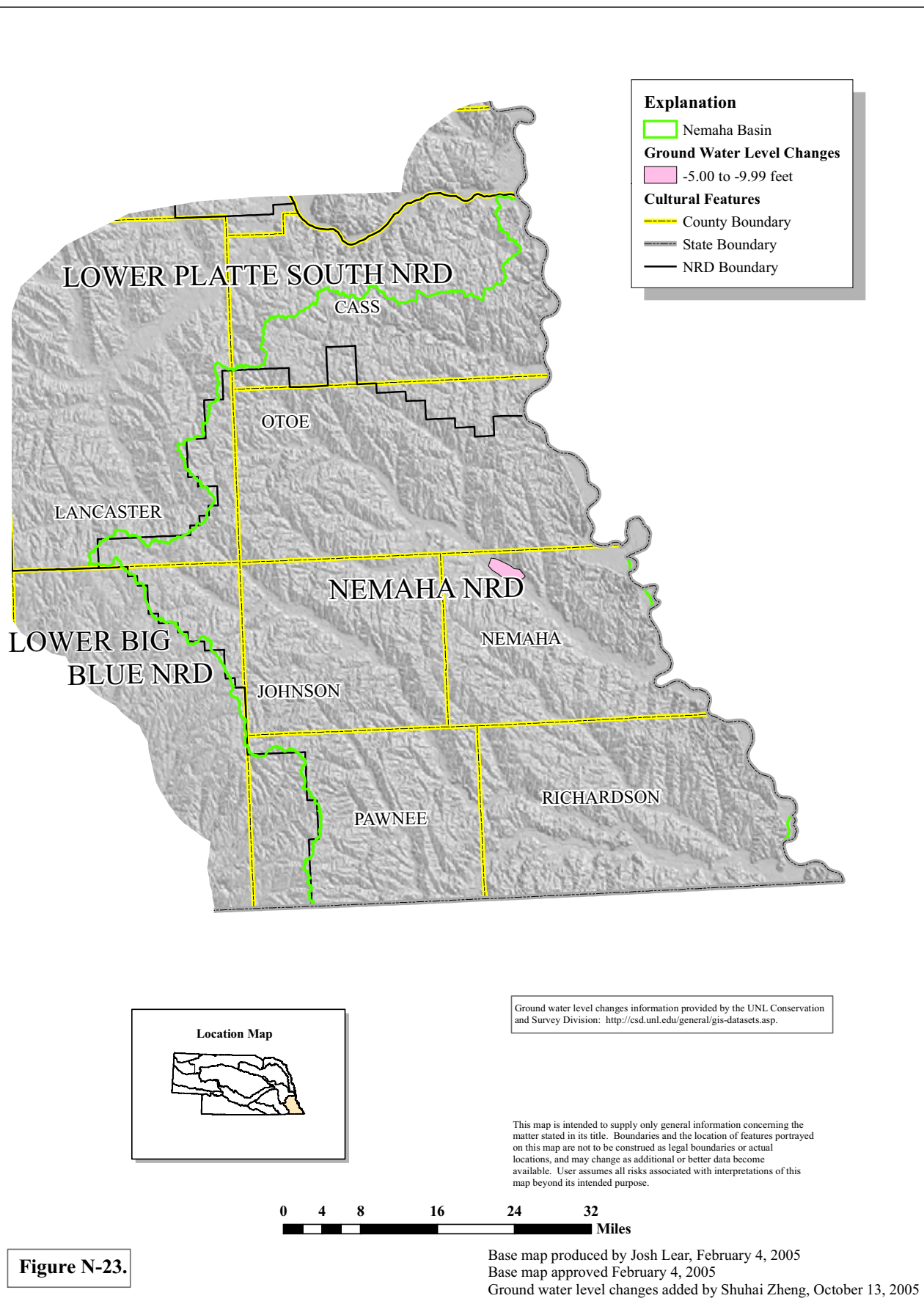
Data Source: <http://www.usda.gov/nass/>, National Agricultural Statistics Service, U.S. Department of Agriculture

Shuhai Zheng, October 20, 2005



Planning and Assistance Division

Ground Water Level Changes Predevelopment to Spring 2005 NEMAHA RIVER BASIN

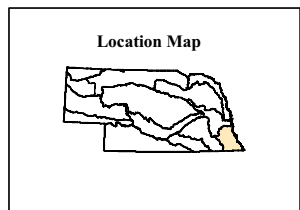
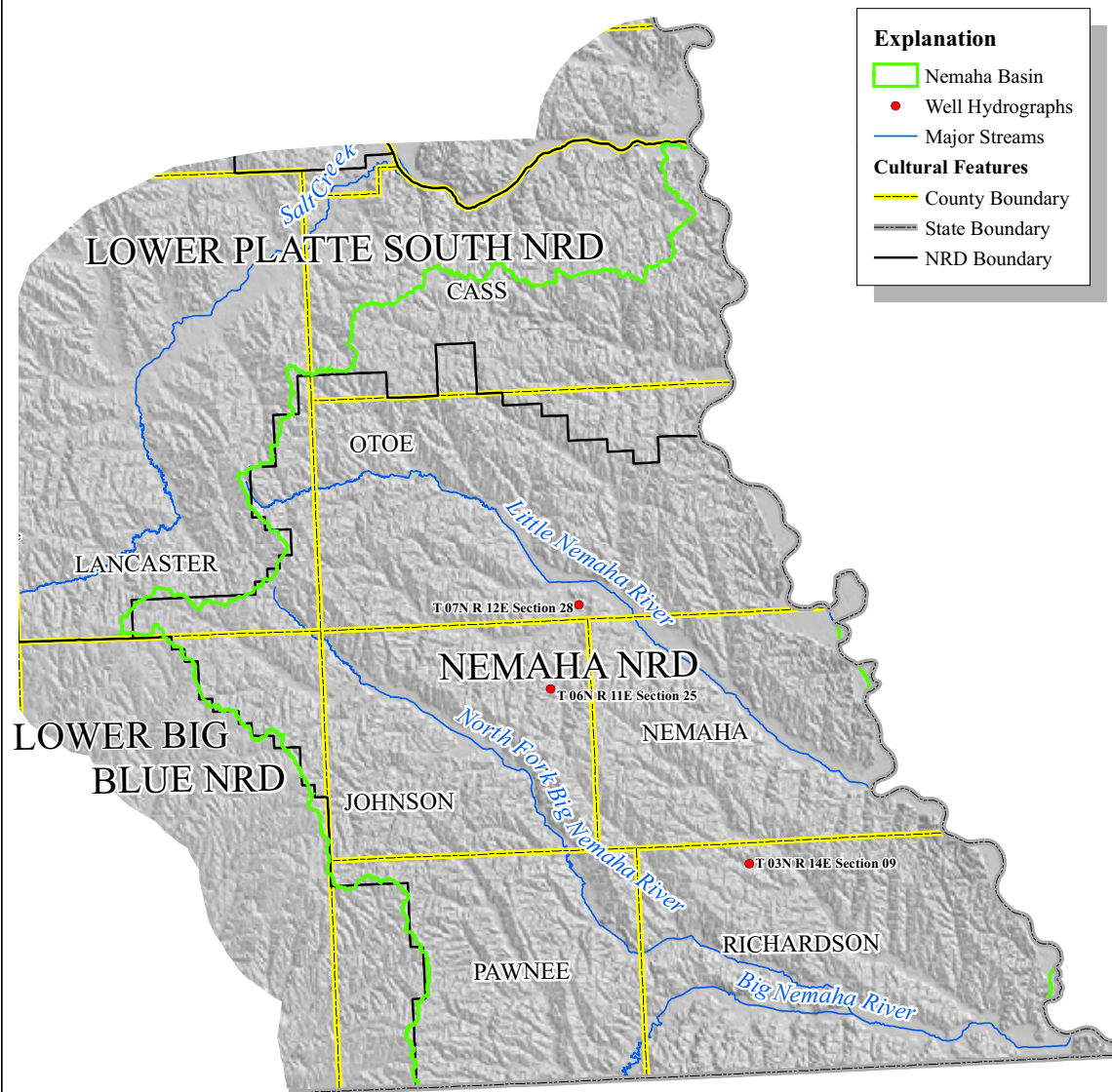




Ground Water Hydrograph Locations NEMAHA RIVER BASIN



Planning and Assistance Division



This map is intended to supply only general information concerning the matter stated in its title. Boundaries and the location of features portrayed on this map are not to be construed as legal boundaries or actual locations, and may change as additional or better data become available. User assumes all risks associated with interpretations of this map beyond its intended purpose.

0 4 8 16 24 32
Miles

Figure N-24.

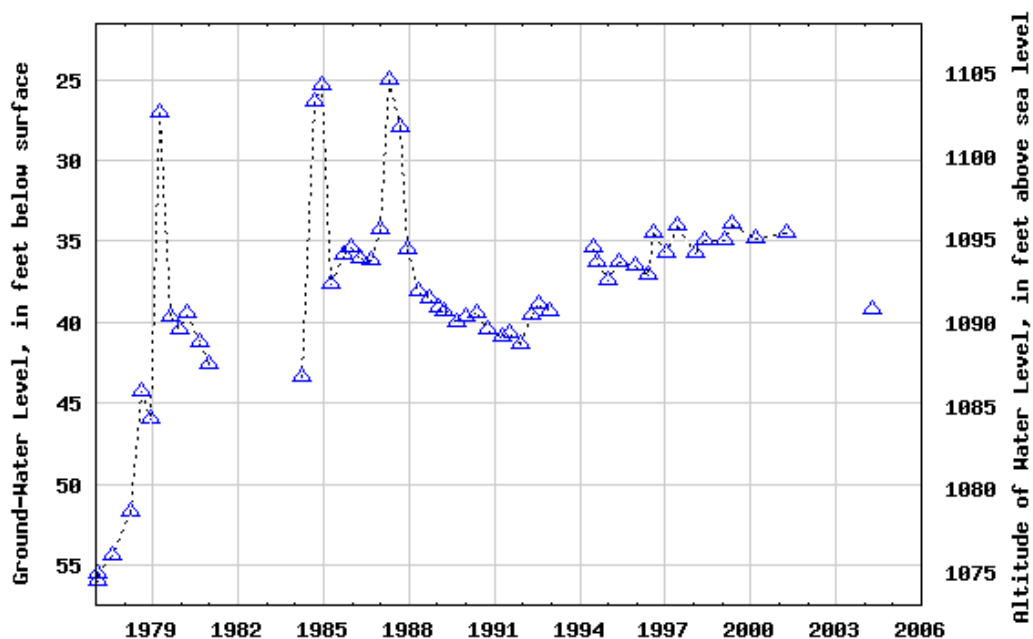
Base map produced by Josh Lear, February 4, 2005

Base map approved February 4, 2005

Ground water hydrograph map produced by Kevin J. Schwartman, November 1, 2005.



USGS 402724096072601 6N 11E25DA 1



Provisional Data Subject to Revision

Johnson County, Nebraska

Hydrologic Unit Code 10240006

Latitude 40°27'24", Longitude 96°07'26" NAD27

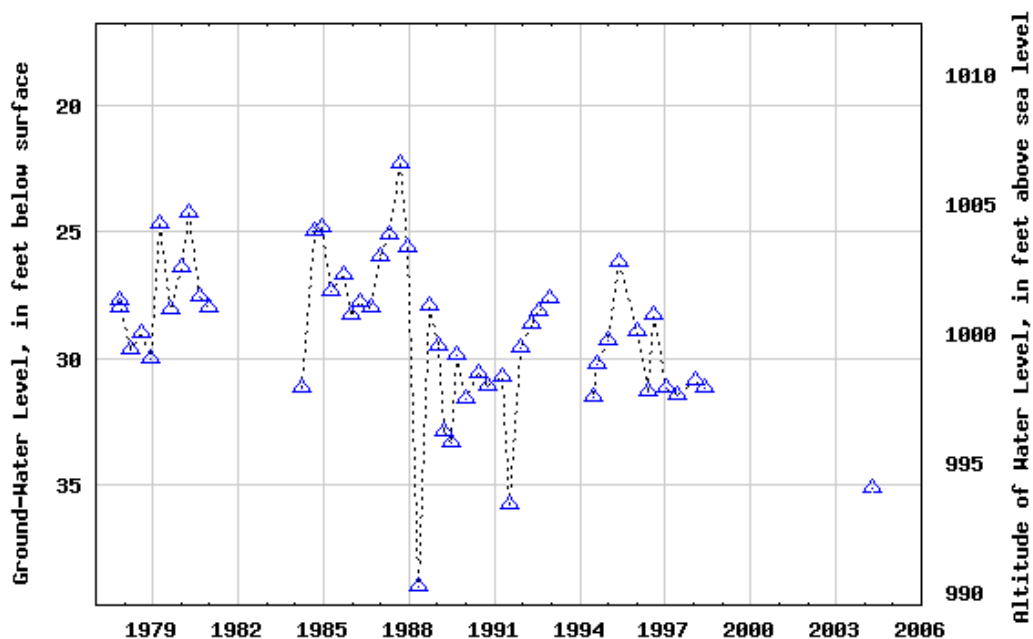
Land-surface elevation 1,130.00 feet above sea level NGVD29

This well is completed in the QUATERNARY SAND AND GRAVEL DEPOSITS (112SDGV) local aquifer.

Figure N-25 (T 06N R 11E Section 25)



USGS 403224096044901 7N 12E28CD 1



Provisional Data Subject to Revision

Otoe County, Nebraska

Hydrologic Unit Code 10240006

Latitude 40°32'24", Longitude 96°04'49" NAD27

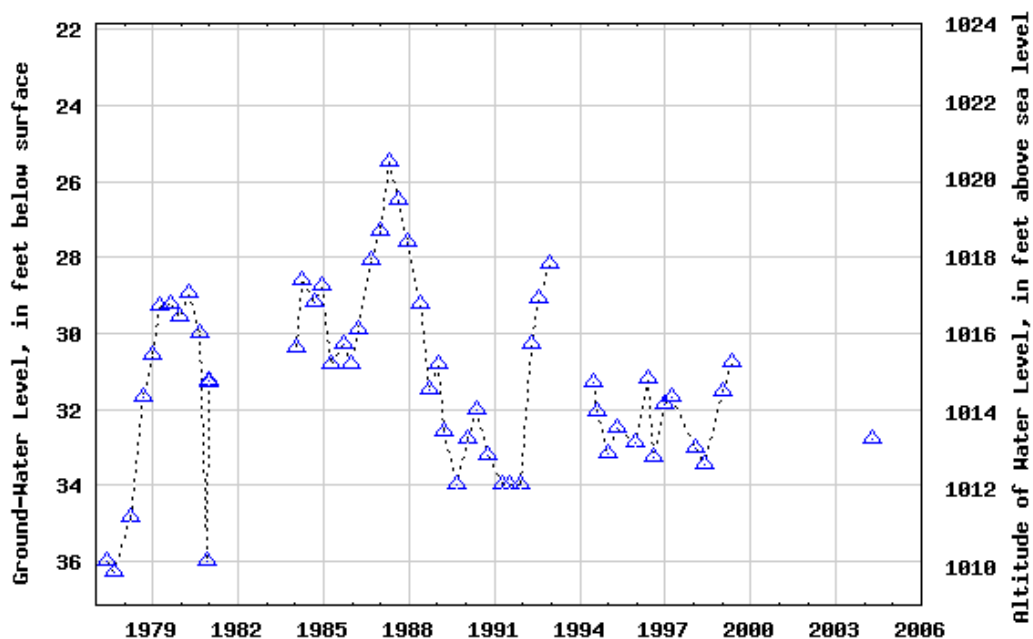
Land-surface elevation 1,029.00 feet above sea level NGVD29

The depth of the well is 76.0 feet below land surface. This well is completed in the QUATERNARY SAND DEPOSITS (112SDGV) local aquifer.

Figure N-26 (T 07N R 12E Section 28)



USGS 401413095504001 3N 14E 9DAC 1



Provisional Data Subject to Revision

Richardson County, Nebraska
Hydrologic Unit Code 10240008
Latitude 40°14'13", Longitude 95°50'40" NAD27
Land-surface elevation 1,046.00 feet above sea level NGVD29
This well is completed in the QUATERNARY SAND AND GRAVEL DEPOSITS (112SDGV) local aquifer.

Figure N-27 (T 03N R 14E Section 09)

Figure N-28. Annual Flows, Weeping Water Creek at Union.

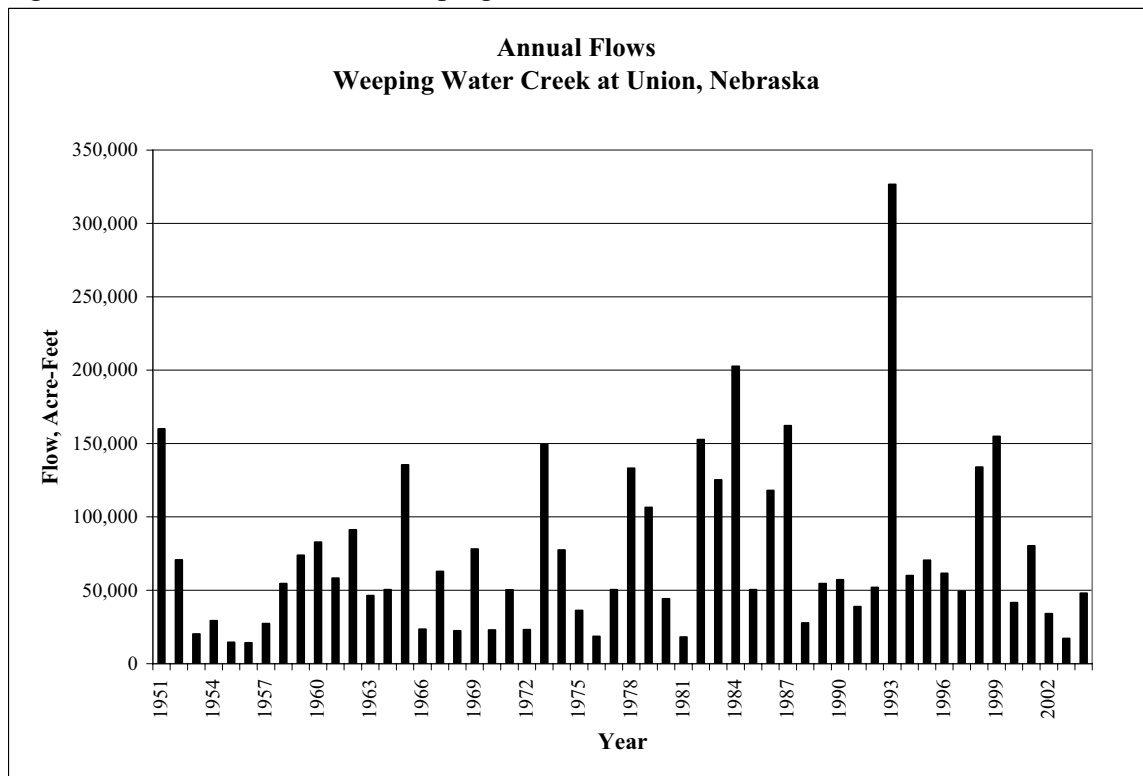
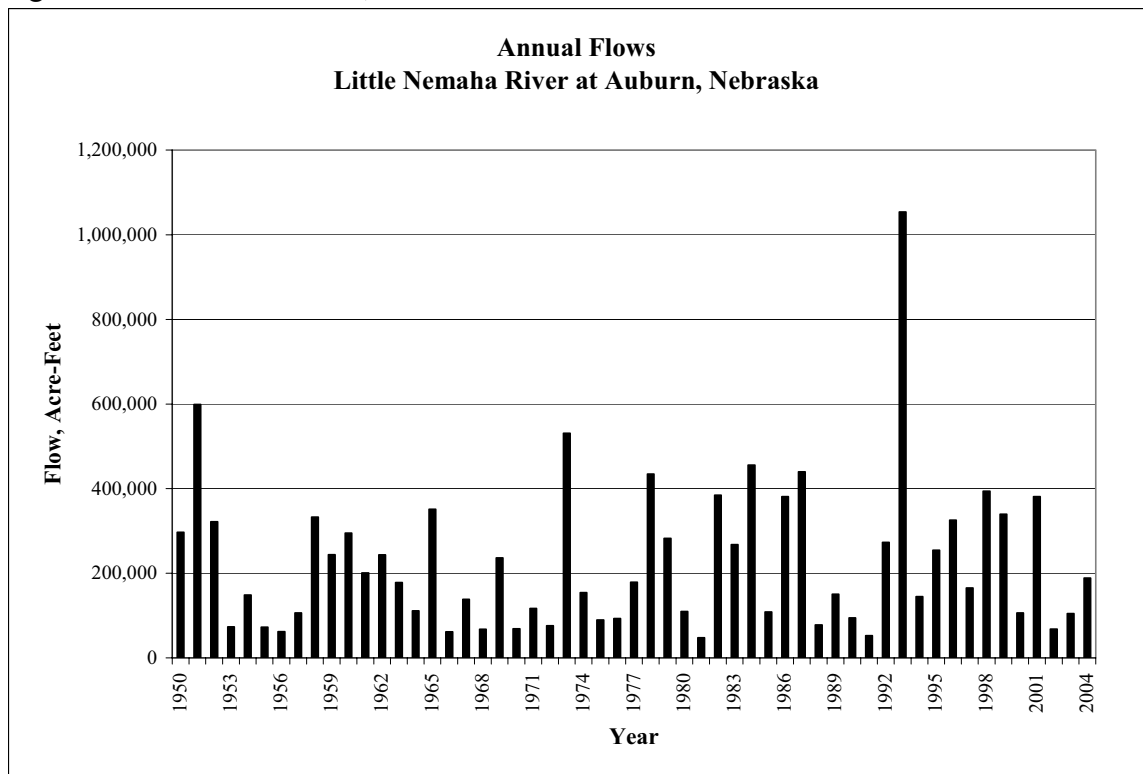


Figure N-29. Annual Flows, Little Nemaha River at Auburn.



Data from: US Geological Survey and NE Department of Natural Resources

Figure N-30. Annual Flows, Big Nemaha River at Falls City.

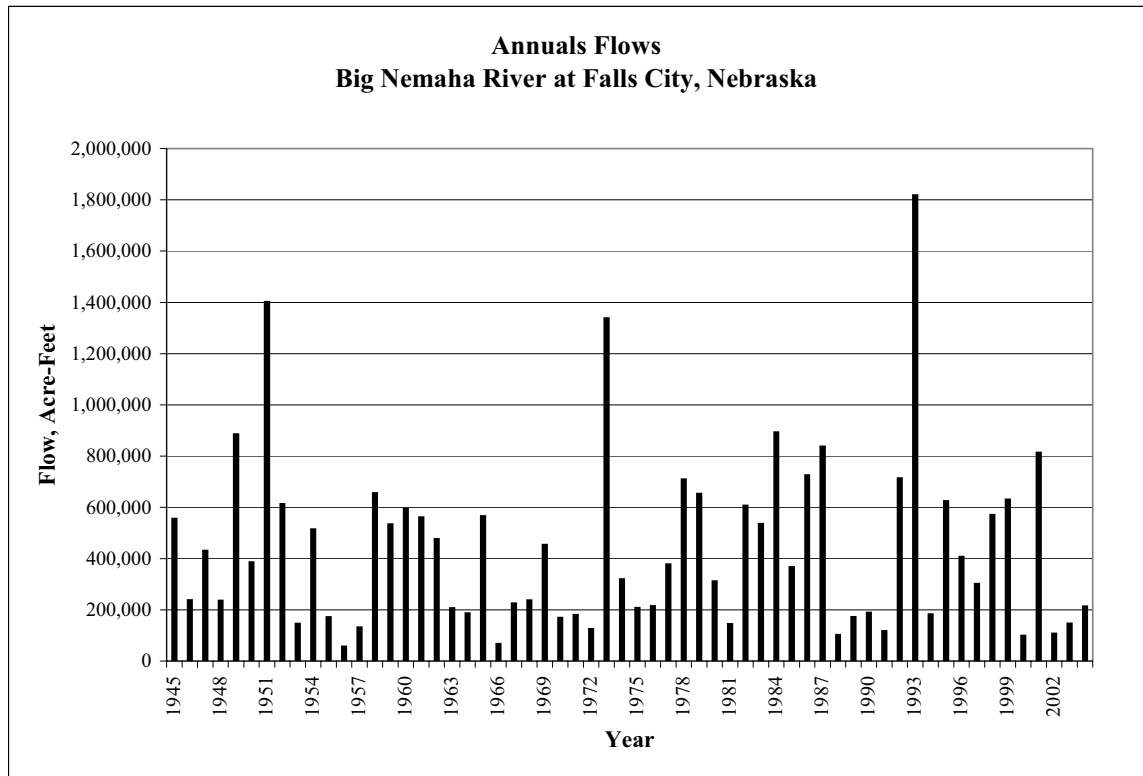
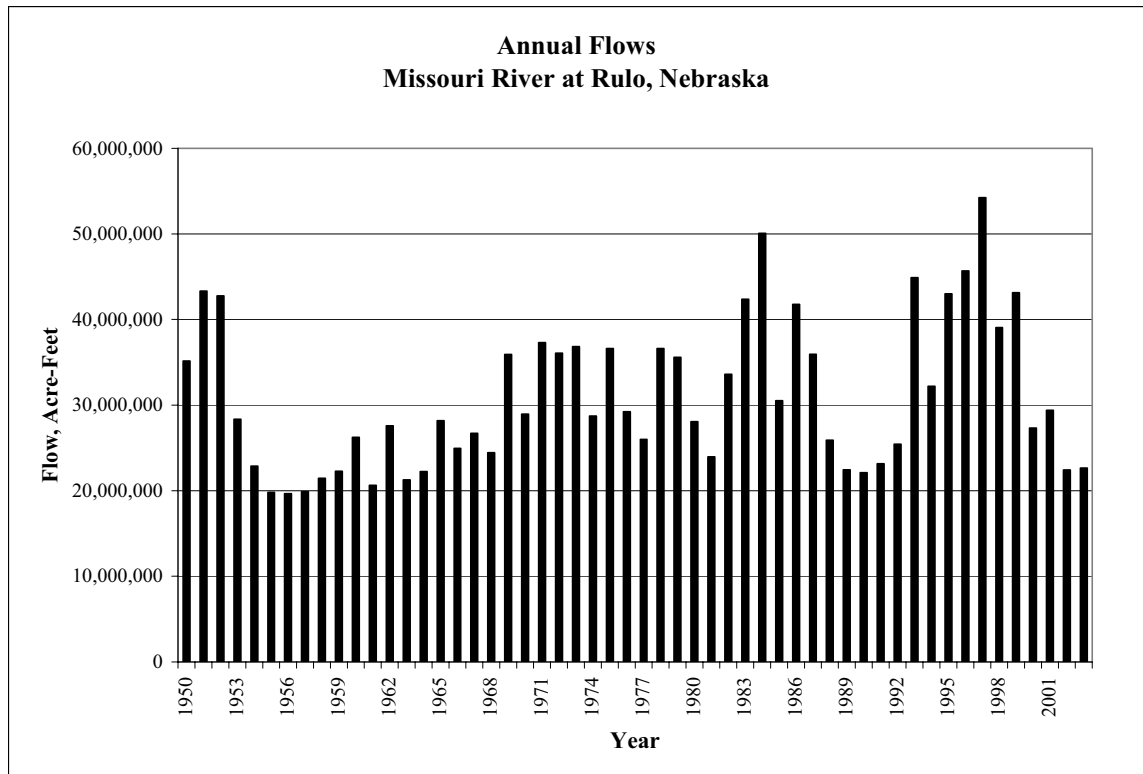


Figure N-31. Annual Flows, Missouri River at Rulo.

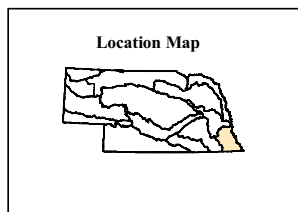
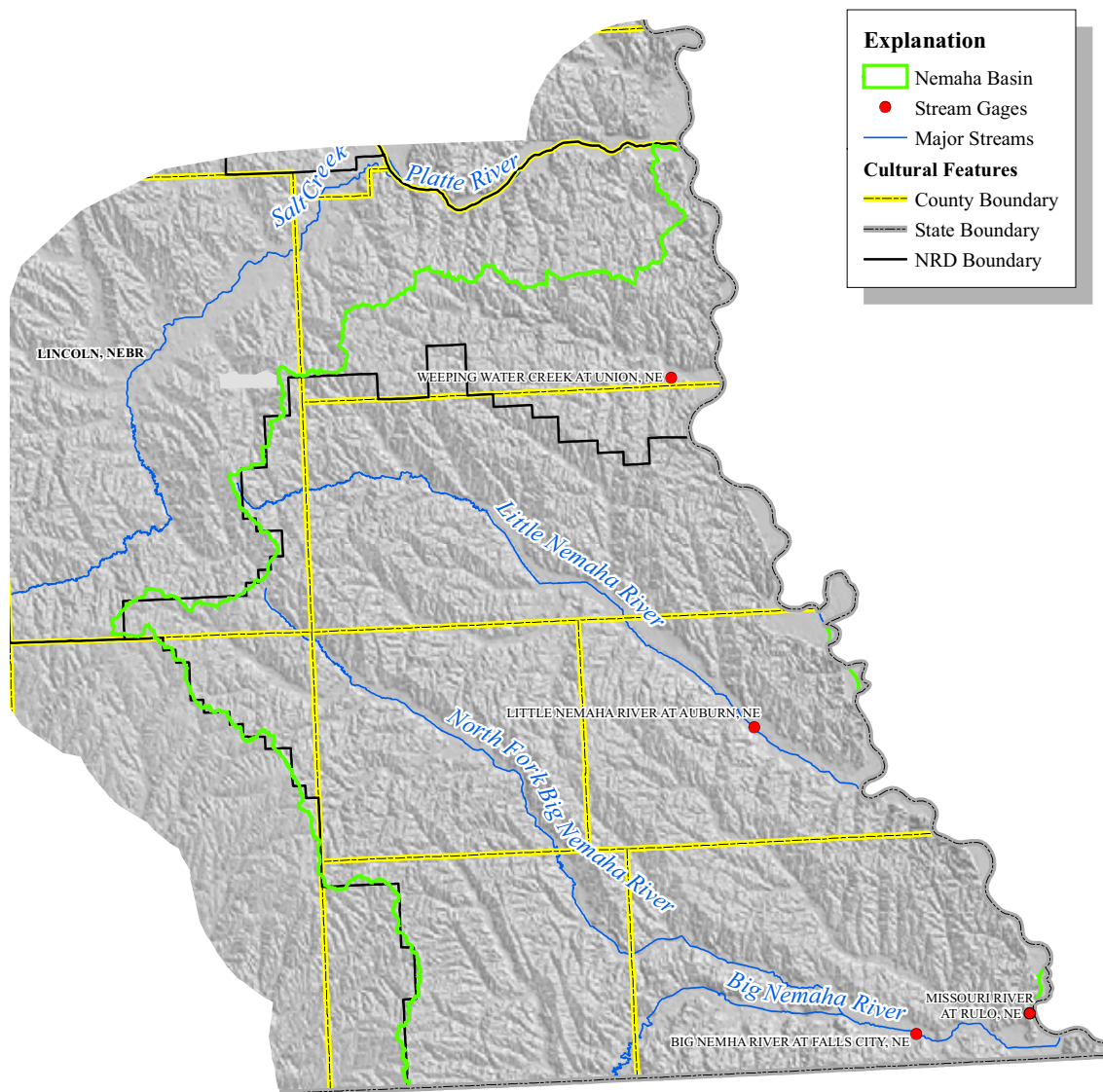


Data from: US Geological Survey and NE Department of Natural Resources



Planning and Assistance Division

Stream Gages NEMAHA RIVER BASIN



This map is intended to supply only general information concerning the matter stated in its title. Boundaries and the location of features portrayed on this map are not to be construed as legal boundaries or actual locations, and may change as additional or better data become available. User assumes all risks associated with interpretations of this map beyond its intended purpose.

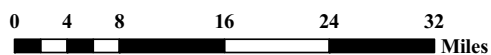
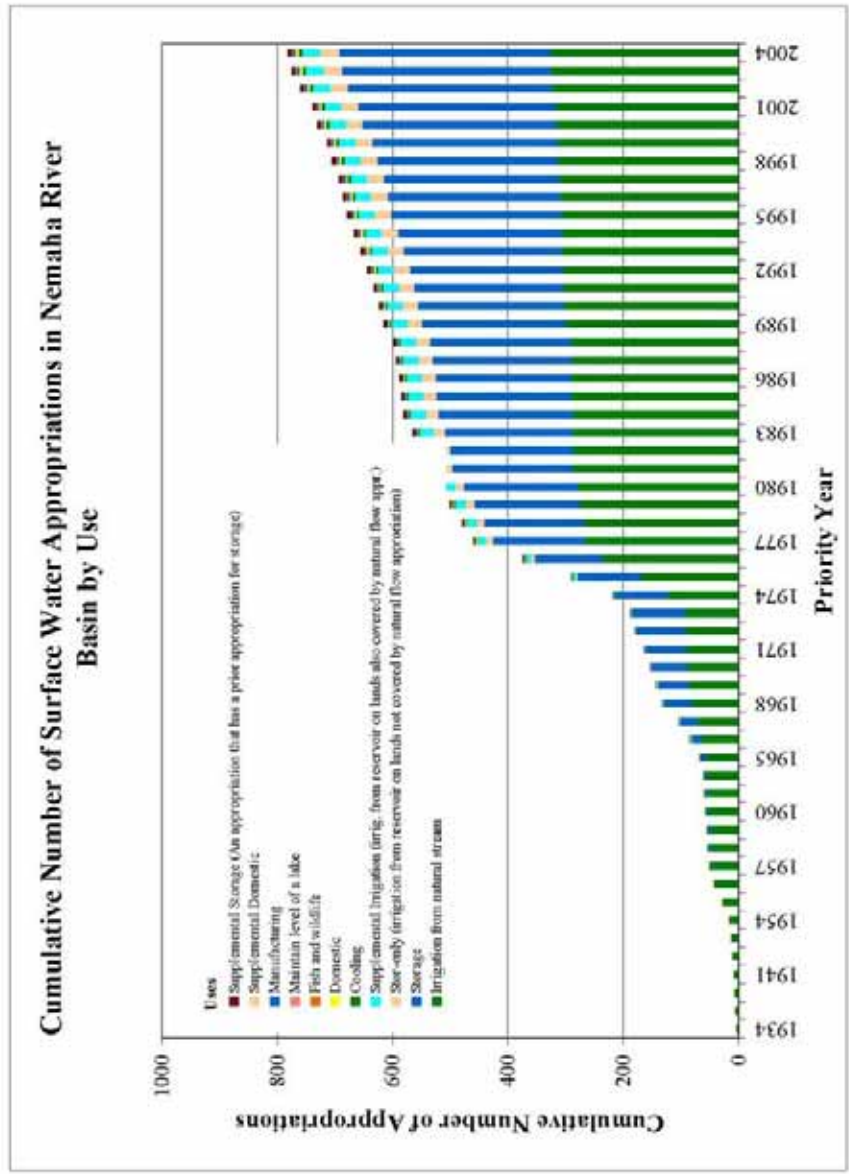


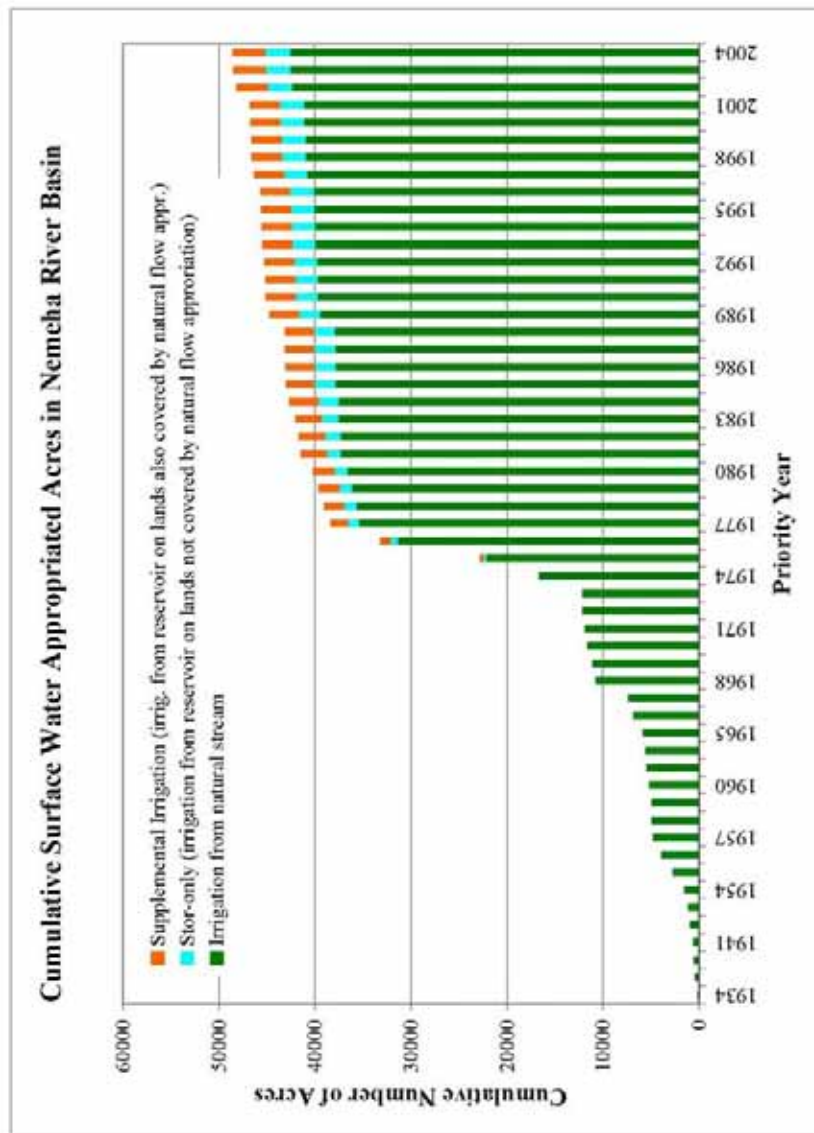
Figure N-32.

Base map produced by Josh Lear, February 4, 2005
Base map approved February 4, 2005
Stream gages map produced by Jeff Shafer, October 18, 2005.



Source: DNR Surface Water Rights Database
Figure N-33

11/13/2005 by Shuhai Zheng



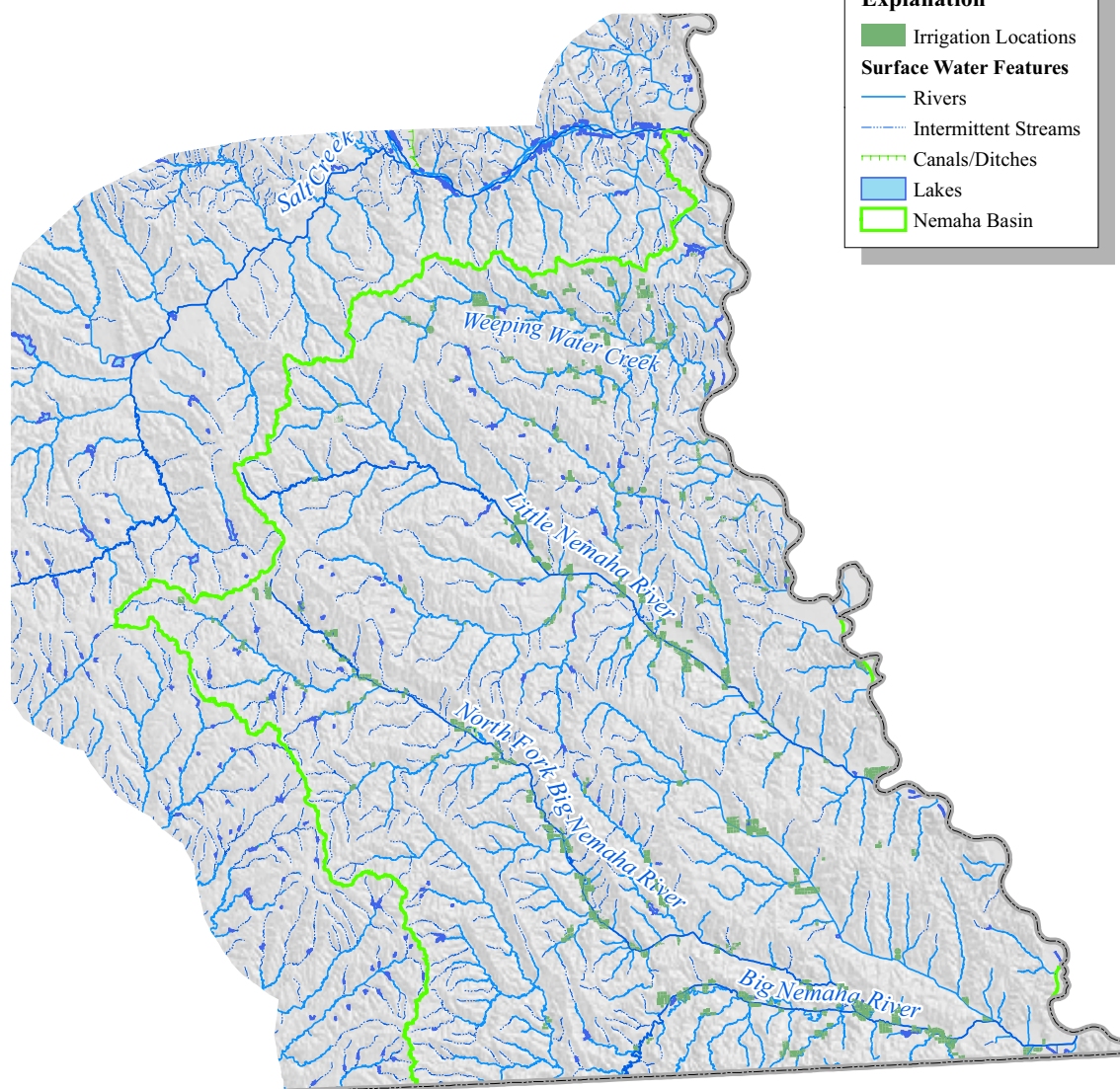
Source: DNR Surface Water Rights Database
Figure N-34

10/1/2005 by Shuhai Zheng

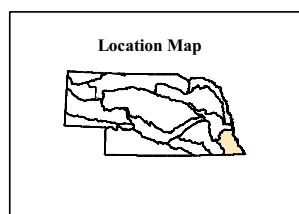


Planning and Assistance Division

Surface Water Irrigation Permit Acres NEMAHA RIVER BASIN



- Explanation**
- Irrigation Locations
 - Surface Water Features**
 - Rivers
 - Intermittent Streams
 - Canals/Ditches
 - Lakes
 - Nemaha Basin



Surface water irrigation permit acres information digitized by DNR staff from surface water irrigation application maps.

This map is intended to supply only general information concerning the matter stated in its title. Boundaries and the location of features portrayed on this map are not to be construed as legal boundaries or actual locations, and may change as additional or better data become available. User assumes all risks associated with interpretations of this map beyond its intended purpose.

0 4 8 16 24 32 Miles

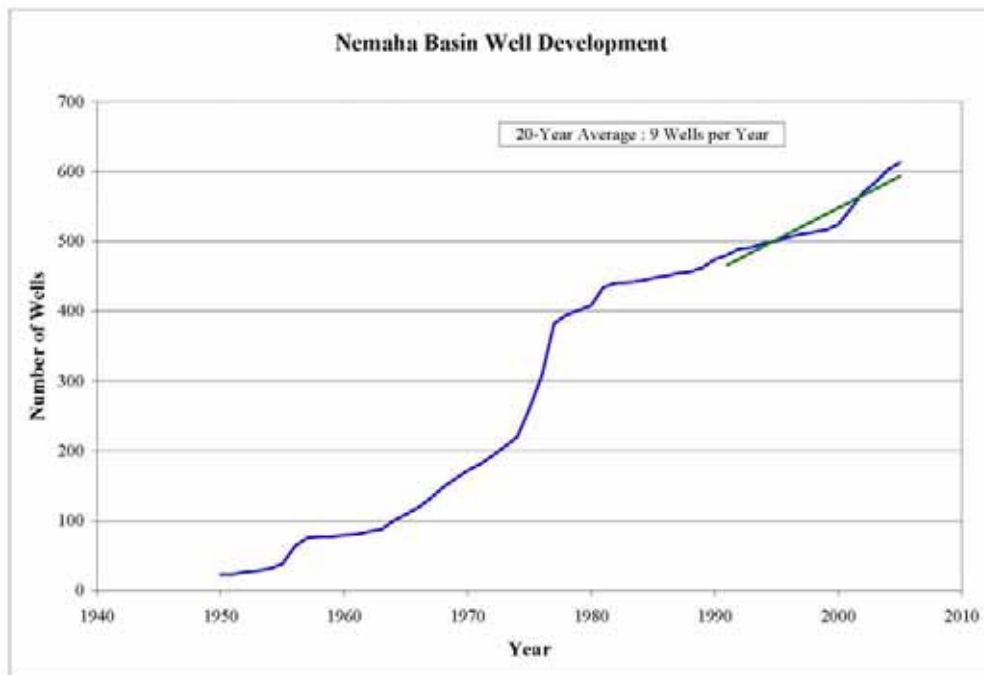
Figure N-35.

Base map produced by Josh Lear, February 4, 2005

Base map approved February 4, 2005

Surface water irrigation locations map produced by Jeff Shafer, October 3, 2005

Figure N-36. Historic High Capacity Well Development in the Nemaha River Basin.

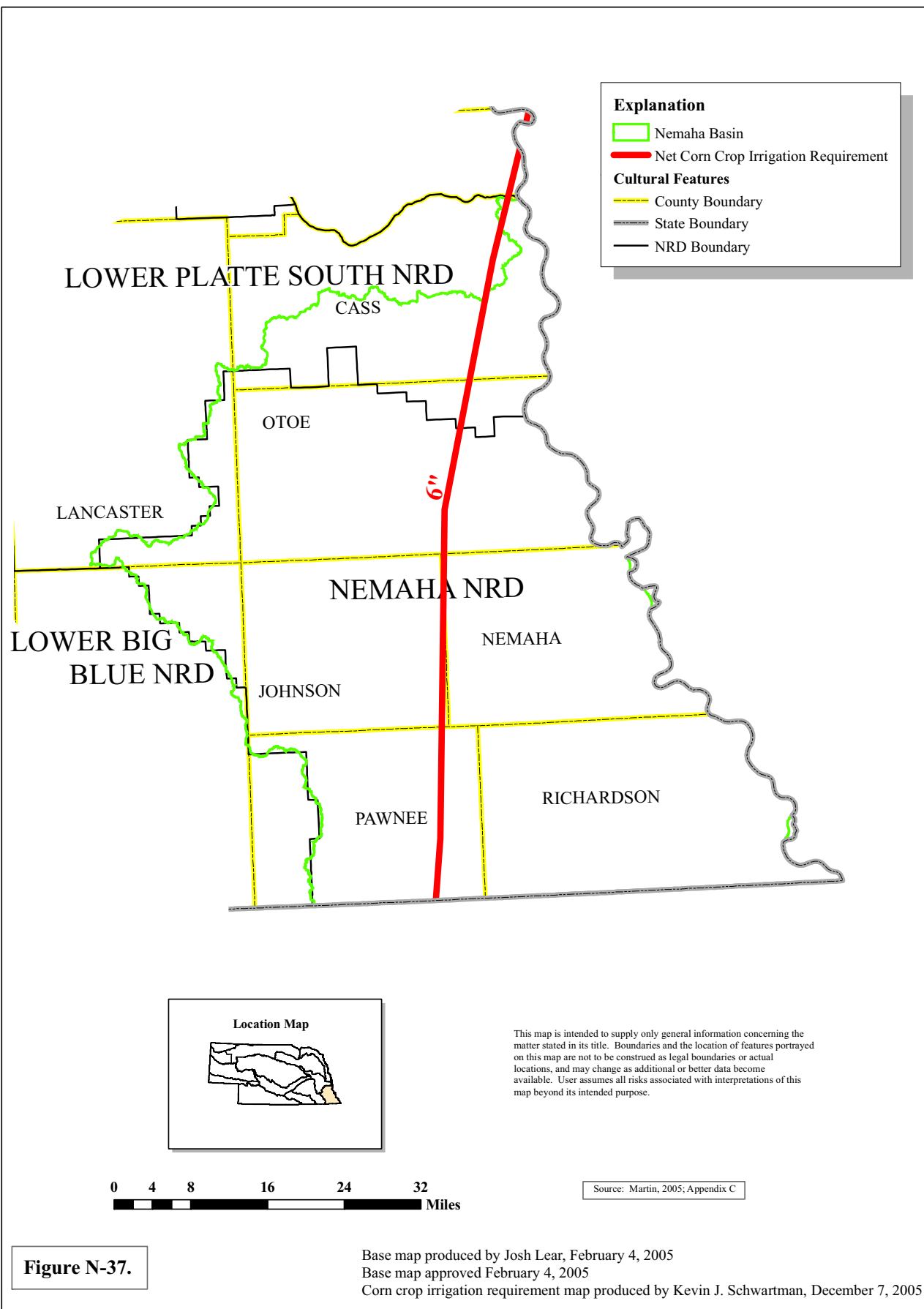


Source: DNR Registered Ground Water Well Database



Planning and Assistance Division

Net Corn Crop Irrigation Requirements NEMAHA RIVER BASIN



Bibliography of Hydrogeologic References for Nemaha Basin

Citation Avery, C. 1978, Groundwater geology of Johnson County: Nebraska, University of Nebraska--Lincoln. Thesis (M.S.)--University of Nebraska--Lincoln.

Citation Bentall, R.& Hamer, T., 1980, Stream-Aquifer Relationships in Nebraska: UNL Conservation and Survey Division and Nebraska Department of Water Resources, 102 pages, 171 illustrations.

Citation Bliss, Q.P., and Schainost, S., 1973, Nemaha Basin stream inventory report: Nebraska Game and Parks Commission, Bureau of Wildlife Services, Aquatic Wildlife Division.

Citation Boohar, J.A., and Provaznik, Mary Kay, 1996, Peak flows for the period of record for current and discontinued streamflow stations in Nebraska: U.S. Geological Survey Open-File Report 96-101, 518 pages.

Citation Brewer, L. D.; Trombley, T. J.; Pomes, M. L., 1994, Water resources on and near Indian lands in northeastern Kansas and southeastern Nebraska; hydrologic data through 1990: U.S. Geological Survey Open-File Report 94-35, 424 pages.

Citation Burchett, R.R., Reed, E. C., 1967. Centennial Guidebook to the Geology of Southeastern Nebraska, University of Nebraska Conservation and Survey Division, Lincoln Nebraska Geological Survey, May, 1967, 83 pages.

Citation Burchett, R.R., Guidebook to the Geology Along the Missouri River Bluffs of Southeastern Nebraska and Adjacent Areas: UNL Conservation and Survey Division, April 1970, 23 pages.